Earth Systems
Environmental Engineering

September 4, 2019

Andrew Park
Hazardous Waste Programs Branch
U.S. Environmental Protection Agency Region 2
290 Broadway, 22nd Fl.
New York, NY 10007-1866

Re: Site Investigation Work Plan - Revised
AOC 103 – Fire Area/Fire Pits
Hess Corporation Former Port Reading Complex (HC-PR)
750 Cliff Road
Port Reading, Middlesex County, New Jersey
Program Interest No. 006148
NJDEP ISRA Case No. E20130449
EPA ID No. NJD045445483

Dear Mr. Park:

Enclosed please find the Site Investigation Work Plan (electronic copy) for AOC 103 – Fire Area/Fire Pits for the above-referenced site. Please feel free to contact me at (732) 739-6444 if you have any questions or require additional information.

Sincerely,

Amy Blake
Senior Project Manager

cc:
Mr. Phil Cole, Case Manager (including 3 paper copies) – NJDEP
Mr. John Schenkewitz, Manager, Remediation - Hess Corporation
Ms. Krista Snyder, Manager, Remediation – Buckeye Partners, L.P.
Mr. Rick Ofsanko – Earth Systems
Mr. John Virgie – Earth Systems

New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

TRADITIONAL/DIRECT OVERSIGHT REPORT CERTIFICATION FORM

Date Stamp
(For Department use only)

SECTION A. SITE NAME AND LOCATION

Site Name: Hess Corporation - Former Port Reading Complex

List All AKAs: Amerada Hess Corp; Buckeye Port Reading Terminal

Street Address: 750 Cliff Road

Municipality: Port Reading (Township Borough or City)

County: Middlesex Zip Code: 07064

Program Interest (PI) Number(s): 006148 Case Tracking Number(s): E20130449

SECTION B. REPORT INFORMATION

Report Name: Site Investigation Workplan - AOC 103 Fire Area/Fire Pits

Report Date: 09/03/2019

Case Type:

☒ **RCRA GPRA 2020** ☐ **CERCLA/NPL** ☐ **USDOD** ☐ **USDOE** ☐ **Direct Oversight**

☐ **Other** (explain):

SECTION C. PERSON RESPONSIBLE FOR CONDUCTING THE REMEDIATION INFORMATION AND CERTIFICATION

Full Legal Name of the Person Responsible for Conducting the Remediation: Hess Corporation

Representative First Name: John Representative Last Name Schenkewitz

Title: Manager, Remediation

Phone Number: (609) 406-3969 Ext: Fax: (732) 352-7795

Mailing Address: 601 Jack Stephan Way; Trenton Mercer Airport

City/Town: Trenton State: NJ Zip Code: 08628

Email Address: jschenkewitz@hess.com

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with Administrative Requirements for the Remediation of Contaminated Sites rule at N.J.A.C. 7:26C-1.5(a).

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

Signature: John Schenkewitz Date: 9/3/19

Name/Title: John Schenkewitz, Manager, Remediation

SECTION D. LICENSED SITE REMEDIATION PROFESSIONAL INFORMATION AND STATEMENT

LSRP ID Number: 576297

First Name: John Last Name: Virgie

Phone Numbers: (732) 739-6444 Ext.: Fax: (732) 739-0451

Mailing Address: 1625 Highway 71

Municipality: Belmar State: NJ Zip Code: 07719

Email Address: jvirgie@earthsys.net

This statement shall be signed by the LSRP who is submitting this notification in accordance with N.J.S.A. 58:10C-14, and N.J.S.A. 58:10B-1.3b(1) and (2).

(1) I certify, as a Licensed Site Remediation Professional authorized pursuant to N.J.S.A. 58:10C-1 et seq. to conduct business in New Jersey, that for the remediation described in this submission, and all attachments included in this submission, I personally: Managed, supervised, or performed the remediation conducted at this site that is described in this submission, and all attachments included in this submission; and/or periodically reviewed and evaluated the work performed by other persons that forms the basis for the information in this submission; and/or completed the work of another site remediation professional, licensed or not, after having: (1) reviewed all available documentation on which I relied; (2) conducted a site visit and observed the then-current conditions and verified the status of as much of the work as was reasonably observable; and (3)concluded, in the exercise of my independent professional judgment, that there was sufficient information upon which to complete any additional phase of remediation and prepare workplans and reports related thereto.

(2) I certify:

- *That I have read this submission and all attachments to this submission;*
- *That in performing the professional services as the licensed site remediation professional for the entire site or each area of concern, I adhered to the professional conduct standards and requirements governing licensed site remediation professionals provided in N.J.S.A. 58:10C-16;*
- *That the remediation conducted at the entire site or each area of concern, that is described in this submission and all attachments to this submission, was conducted pursuant to and in compliance with the remediation requirements in N.J.S.A. 58:10C-14.c;*
- *That the remediation described in this submission, and all attachments to this submission, was conducted pursuant to and in compliance with the regulations of the Site Remediation Professional Licensing Board at N.J.A.C. 7:26I; and*
- *That the information contained in this submission and all attachments to this submission is true, accurate, and complete.*

(3) I certify, when this submission includes a response action outcome, that the entire site or each area of concern has been remediated in compliance with all applicable statutes, rules, and regulations and is protective of public health and safety and the environment.

(4) I certify that no other person is authorized or able to use any password, encryption method, or electronic signature that the Board or the Department have provided to me.

(5) I certify that I understand and acknowledge that:

- *If I knowingly make a false statement, representation, or certification in any document or information I submit to the Department I may be subject to civil and administrative enforcement pursuant to N.J.S.A. 58:10C-17.a.1(a)through (f) by the Board, including but not limited to license suspension, revocation, or denial of renewal; and*
- *If I purposely, knowingly, or recklessly make a false statement, representation, or certification in any application, form, record, document or other information submitted to the Department or required to be maintained pursuant to the Site Remediation Reform Act, I shall be guilty, upon conviction, of a crime of the third degree and shall, notwithstanding the provisions of subsection b. of N.J.S.2C:43-3, be subject to a fine of not less than $5,000 nor more than $75,000 per day of violation, or by imprisonment, or both.*

(6) I certify that I have read this certification prior to signing, certifying, and making this submission.

LSRP Signature: Date: 9/4/18

LSRP Name: John Virgie

Company Name: Earth Systems

Completed forms should be sent to:

Assigned Case Manager
Bureau of Case Management
Site Remediation Program
NJ Department of Environmental Protection
401-05F
PO Box 420
Trenton, NJ 08625-0420

SITE INVESTIGATION WORKPLAN

AOC 103 – Fire Area/Fire Pits
Hess Corporation – Former Port Reading Complex
(HC-PR)
750 Cliff Road,
Port Reading, Middlesex County, New Jersey
NJDEP PI# 006148
ISRA Case No. E20130449
EPA ID No. NJD045445483

September 2019

Prepared for:

Hess Corporation

Trenton-Mercer Airport
601 Jack Stephan Way
West Trenton, New Jersey 08628

Prepared By:

Earth Systems
Environmental Engineering

1625 Route 71
Belmar, New Jersey 07719

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FIGURES

APPENDICES

1.0 INTRODUCTION

On behalf of Hess Corporation (Hess), Earth Systems, Inc. (Earth Systems) has prepared this revised Site Investigation Workplan (SIW) for the environmental Area of Concern (AOC) designated as AOC 103 – Fire Area/Fire Pits at the Hess Corporation Former Port Reading Complex (HC-PR), located at 750 Cliff Road, in Port Reading (Woodbridge Township), Middlesex County, New Jersey (the Site).

A United States Geological Survey (USGS) 7.5 minute series quadrangle map (Arthur Kill, New Jersey), depicting the HC-PR facility and associated land features is presented as **Figure 1** and the location of AOC 103 is presented as **Figure 2**.

Due to historic operations, the Site is jointly regulated by both the New Jersey Department of Environmental Protection (NJDEP) and the Environmental Protection Agency (EPA). The NJDEP Industrial Site Recovery Act (ISRA) was triggered when Hess Corporation executed an agreement to sell the Port Reading Complex to Buckeye Partners, LP (Buckeye). The Site is regulated under EPA's Resource Conservation and Recovery Act (RCRA) since former operations at the Site required the treatment, storage, and disposal of hazardous waste.

In accordance with the New Jersey Technical Requirements for Site Remediation (7:26E-4.1d), this SIW is being submitted for approval since the Site is regulated under RCRA, in addition to being subject to reporting requirements under ISRA. This SIW is an AOC specific plan solely intended to address the investigation of AOC 103 – Fire Area/Fire Pits. The SIW was originally submitted to the NJDEP and EPA on May 9, 2019. The NJDEP reviewed the SIW and provided comments on May 22, 2019. A conference call was conducted on this date with representatives from Hess, Earth Systems, the EPA, and the NJDEP and the comments were briefly discussed. Additionally, during the regularly scheduled NJDEP, EPA, and Hess meeting on June 20, 2019, the comments were extensively reviewed. This SIW has been revised in accordance with the May 2019 comment letter, May 2019 conference call, and June 2019 meeting. A copy of the NJDEP comment letter and subsequent Hess/Earth Systems response is included as **Appendix A**.

The following SIW provides a summary of historic relevant operations and the potential impacts associated with AOC 103. Following the summary, the recommended scope of work is designed to evaluate groundwater quality beneath AOC 103 to satisfy New Jersey Department of Environmental Protection (NJDEP) requirements in accordance with the New Jersey Administrative Code (N.J.A.C.) 7:26E, *The Technical Requirements for Site Remediation (TRSR)*; N.J.A.C 7:26C, *The Administrative Requirements for the Remediation of Contaminated Sites (ARRCS)*; N.J.S.A. 58:10C-1 et seq., *The Site Remediation Reform Act (SRRA)*; and the associated NJDEP SRRA Guidance Documents. Information obtained during the proposed investigation activities will be documented in an AOC 103 Site Investigation Report (SIR), the site-wide Ecological Risk Assessment (ERA), and the CA725 and CA750 EPA Environmental Indicator (EI) Reports.

2.0 BACKGROUND

2.1 Site Description

The HC-PR facility is an approximate 210-acre irregularly shaped parcel, situated in an industrially developed waterfront area. A Site Location Map for the HC-PR facility is presented as **Figure 1**. The HC-PR facility is identified as Block 756, Lot 3; Block 756.01, Lots 1.02, 2, and 3; Block 756.02, Lots 1 and 8; Block 757, Lot 1; Block 760, Lot 6; Block 760.01, Lots 2 and 3; Block 760.02, Lots 1, 2, and 3; Block 1096.01, Lot 6, and Block 664.01, Lots 1.01 and 1.02.

The HC-PR facility is located east of Cliff Road and abuts the southern property boundary of the Conrail Port Reading Rail yard. Immediately east-southeast of the facility is the Arthur Kill shipping channel, and to the southwest is the PSE&G Sewaren Generating facility. The former Port Reading Coal Docks, currently owned by Prologis, Inc. are located to the northeast. Port Reading Avenue is located to the northwest. A mixture of industrial and commercial properties are located to the west. Two (2) residential properties are located up-gradient to the northwest, and an industrial property is located to the south.

The HC-PR facility formerly processed low sulfur gas oils and residuals as feed to a Fluidized Catalytic Cracking Unit (FCCU) that converted gas oil into gasoline, fuel oil, and other hydrocarbon products (e.g. methane, ethane and liquid petroleum gas). The HC-PR site operations were initiated in 1958 with a Crude Topping Unit and underwent various expansions between 1958 and 1970. In 1974, refining operations were suspended and the facility operated only as a bulk storage and distribution terminal until 1985. In April 1985, following a retrofit, the HC-PR facility resumed refining operations. In 2013, the Site was sold to Buckeye and is currently operated only as a bulk storage and distribution terminal.

AOC 103 – Fire Area/Fire Pits

Aqueous Film Forming Foams (AFFF) were developed and began being used as fire suppressants for fire training/fire-fighting at military bases, airports, and oil refineries/terminals in the 1960s. AFFFs contain a mixture of poly fluroalkyl substances (PFAS), which have been identified as emerging contaminants of concern by the NJDEP.

There have been no documented fires or AFFF releases for the Site. Therefore, the fire fighting training area and the AFFF storage area (see below) are the most likely locations for potential PFAS impacts at the Site.

Training Area

Based on a review of historic aerials and input from the former Hess Fire Chief and former Health and Safety Specialist, the northeast corner of the Site was occupied by fire pits that were utilized for the training of fire and safety personnel from approximately the 1960's to the 1980's. Fires were set using different accelerants in order to determine the correct fire suppressant to use. See **Figures 3** and **4** for the location of AOC 103 – Fire Area/Fire Pits and **Appendix B** for copies of historic aerial photographs of AOC 103.

AFFF Storage

Based on interviews with Hess personnel, AFFF was stored in the above referenced fire fighting training area (See **Figures 3** and **4**). Buckeye currently stores AFFF in a tanker truck in the

parking lot located to the north of the administration building (See **Figure 5**). There is no record of Hess having ever stored AFFF in this location.

2.2 Site Geology and Hydrogeology

The geology of the HC-PR facility was determined from the data collected at the HC-PR facility, during the subsurface investigations, and from the Geologic Map of the State of New Jersey. The HC-PR facility is underlain by the Magothy and Raritan formations, which are the lowest members of the Cretaceous-age Coastal Plain physiographic sediments. The Raritan Formation consists of sands and clays of variable color and grain size, and the overlying Magothy Formation consists of dark lignitic sand and clay containing glauconite near the top. The western section of the HC-PR facility is underlain by a thick clay unit, while marsh deposits underlie the eastern and southeastern section of the HC-PR facility.

The shallow unconfined water table at the HC-PR facility was encountered between approximately 2 and 11 feet below ground surface (bgs). Groundwater flow is predominately southeasterly in the northwest portion of the HC-PR facility and east-southeasterly in the central portion of the HC-PR facility. The HC-PR facility wells located adjacent the Arthur Kill and North Drainage Ditch are affected by tidal influences. Wells located further away from the Arthur Kill are generally unaffected by tidal influence. An average hydraulic gradient of approximately 0.001 feet /per feet was calculated for the Site.

2.3 Topography and Surface Water

Topography of the Site and surrounding area is generally flat with a very gradual slope downward toward the Arthur Kill. The total difference in topographic relief on the developed portion of the site is less than 5 feet. Surveyed ground surface elevations indicated that the developed portion of the property, which has an approximate total area of 210 acres, ranges in elevation from 5 to 10 feet above MSL referenced to North American Vertical Datum of 1988 (NAVD88).

The topography of the area designated as AOC 103 – Fire Area/Fire Pits was reportedly lower than the surrounding elevation. The Arthur Kill is located approximately 350 feet east of AOC 103.

3.0 SITE INVESTIGATION: AOC 103 – FIRE AREA/FIRE PITS

3.1 History

HC-PR began operations on the Site in 1958. As part of safety training activities conducted during Hess' operation of the refinery, fires were set and extinguished with water or possibly AFFF which potentially contained PFAS. Based upon a review of historic aerials and discussions with Hess personnel, the location of the fire training area (AOC 103) was identified in the northeastern corner of the Site. This area was undeveloped/unpaved and was utilized as a fire training area from the 1960's to the 1980's.

3.2 Description of Current Conditions

The former fire pits were located in the area currently utilized as the terminal's laydown yard and the surface is now covered with asphalt. A potential drainage channel (also being investigated) is located to the east of the current laydown yard and that area is vegetated.

3.3 AOC 103 – Fire Area/Fire Pits Proposed Investigation

As per the NJDEP issuance of "Site Remediation & Waste Management Program Implementation of March 13, 2019 Interim Specific Groundwater Quality Standards," a determination must be made for all Sites on whether PFAS were used, stored, or discharged at a Site. The former fire training area (AOC 103) was identified as part of the historical review of the Site. Therefore, there is a possibility that AFFF containing PFAS was used as part of fire training activities conducted at AOC 103.

In accordance with the above NJDEP memo, a site investigation of PFAS in the groundwater is required for the Site. Earth Systems recommends the installation of seven monitoring wells to investigate the presence of potential groundwater impacts associated with this particular historic use of AFFFs. All monitoring wells will be installed by a licensed well driller. A monitoring well will be installed in each of the darkened areas (believed to be the fire pit areas) identified on historic aerials (1966-1980). A monitoring well will also be installed in a potential drainage channel identified by the NJDEP and in a "ponding area" downgradient of the former fire pit areas. The monitoring well locations are illustrated on **Figures 3** and **4**.

Pursuant to direction from the NJDEP and EPA, Buckeye's current storage location of AFFF (utilized to support their operations of the facility) will also require investigation. There are no records that indicate Hess utilized this area for storage of AFFF or for any fire fighting training activities. However, as per the NJDEP and EPA, an additional monitoring well will be installed down-gradient of the current Buckeye AFFF storage location. The monitoring well location is illustrated on **Figure 5**.

As per Hess and Buckeye safety protocols, all monitoring well locations are required to be pre-cleared to 6 or 8 feet below grade depending on their proximity to a known asset (pipelines, underground structures, tanks, etc.). Pre-clearing protocols include notification to NJ One Call, a private mark-out utilizing Ground Penetrating Radar (GPR) survey methods, and an evaluation of available as-built drawings of the Site. The monitoring well locations will be hand-cleared to a minimum depth of 6.0 to 8.0 feet below grade using a hand auger. However, if hand-augering is not possible due to field conditions, the boring locations will be pre-cleared using air knifing/vacuum extraction. At depths greater than 8 feet below grade, the monitoring well borings will be advanced utilizing GeoProbe® direct push technology. Soil lithology will be logged and evaluated during monitoring well installation. Observations such as depth to water, odors, staining, changes in soil type, the presence of fill, etc. will be recorded on the monitoring well log for eventual submittal with the AOC 103 – Fire Area/Fire Pits RIR. Based on the observed depth to groundwater, the monitoring wells will be constructed so that the screen interval of the well will intersect the groundwater table.

The monitoring wells will be installed to an approximate total depth of 15 feet below grade with a screened interval from 3 to 15 feet below grade. The monitoring wells will be constructed using PVC components, as discussed with the NJDEP during the May 22, 2019 conference call. All drill cuttings, development water, and purge water will be drummed for offsite disposal.

A soil investigation is not being recommended for AOC 103 – Fire Area/Fire Pits. Soil analysis is not being conducted since current NJDEP guidance only requires a groundwater investigation. In addition, there are no promulgated soil standards to compare to the soil analytical results. If soil investigation guidance or soil standards are promulgated by the

NJDEP at some point in the future, a workplan will be prepared to address these new requirements and submitted to the NJDEP for approval prior to implementation.

Groundwater Sample Collection

Approximately two weeks after monitoring well installation, groundwater samples will be collected from all AOC 103 monitoring wells for the following analysis:

- perfluorooctanoic acid – PFOA
- perfluorooctanesulfonic acid – PFOS
- perfluorononanoic acid - PFNA

As per the Interstate Technology and Regulatory Council (ITRC) AFFF fact sheet, AFFF manufactured between the 1960's to 2002 made by 3M contained PFOS and possibly PFOA; AFFF not made by 3M had components that break down to PFOA over time. Therefore, analysis of PFOA and PFOS is appropriate to determine potential impacts from historic use of AFFF. All analysis of groundwater samples will be conducted by a NJDEP certified and NELAC accredited certified laboratory. (SGS North America – Orlando, NJDEP Lab #FL002) in compliance with the approved method (modified EPA 537). In addition to the above analysis, groundwater samples will also be analyzed for Total Organic Carbon (TOC), Total Dissolved Solids (TDS), chloride, Volatile Organic Compounds (VOCs+TICs), and Semi-Volatile Organic Compounds (SVOCs+TICs).

Groundwater samples will be collected utilizing a three volume purge method. As explained in the QAPP (**Appendix C**), PFAS are potentially found in equipment typically used to collect groundwater samples. Therefore, disposable polyethylene (poly) tubing will be used to purge each well and poly bailers will be used to collect the groundwater samples. See **Appendix C** for a complete description of the groundwater sampling protocol for PFAS.

Groundwater Analytical Data Evaluation

If PFAS are detected in the groundwater samples at concentrations exceeding the current Interim Groundwater Quality Standard, additional groundwater investigation will be proposed in accordance with the NJDEP *Groundwater Technical Guidance: Site Investigation, Remedial Investigation, and Remedial Action Performance Monitoring* guidance documents. A Remedial Investigation Workplan (RIW) will be prepared for review and approval by the NJDEP and EPA prior to conducting any remedial groundwater investigation activities.

If additional groundwater delineation is required, site specific information (preferential pathways, area obstructions, etc.) will be included in the evaluation of potentially impacted areas and the placement of additional groundwater monitoring wells. The current existing monitoring well network at the Site may be used, if necessary, for additional groundwater delineation.

If PFAS are not detected in the groundwater samples collected from the AOC 103 monitoring wells, Earth Systems/Hess will discuss the analytical results and investigation observations with the NJDEP and EPA to confirm that no additional investigation is warranted.

3.4 Quality Assurance Project Plan

A NJDEP certified (SGS Orlando NJDEP Lab #FL002) and NELAC accredited laboratory is being utilized to conduct analysis of the groundwater samples. A copy of the laboratory's

approved analytical methods and accreditation certificate has been included in **Appendix C**. All groundwater sampling protocols will comply with the approved method (modified EPA 537).

Samples will be collected in accordance with the sampling procedures outlined in the QAPP, which is included as **Appendix C**. The QAPP will provide guidance to the project team to ensure all field activities are completed in a manner consistent with the NJDEP requirements and that all data produced is of sufficient quality to meet NJDEP standards. Analytical data packages will be presented in the New Jersey Reduced Deliverables format, including electronic data deliverables (EDDs).

3.5 Health and Safety Plan

A Site-specific HASP will be prepared in accordance with NJAC 7:26E-1.9. All Site personnel will be informed prior to performing any site activities of all health and safety protocols.

4.0 RECEPTOR EVALUATION

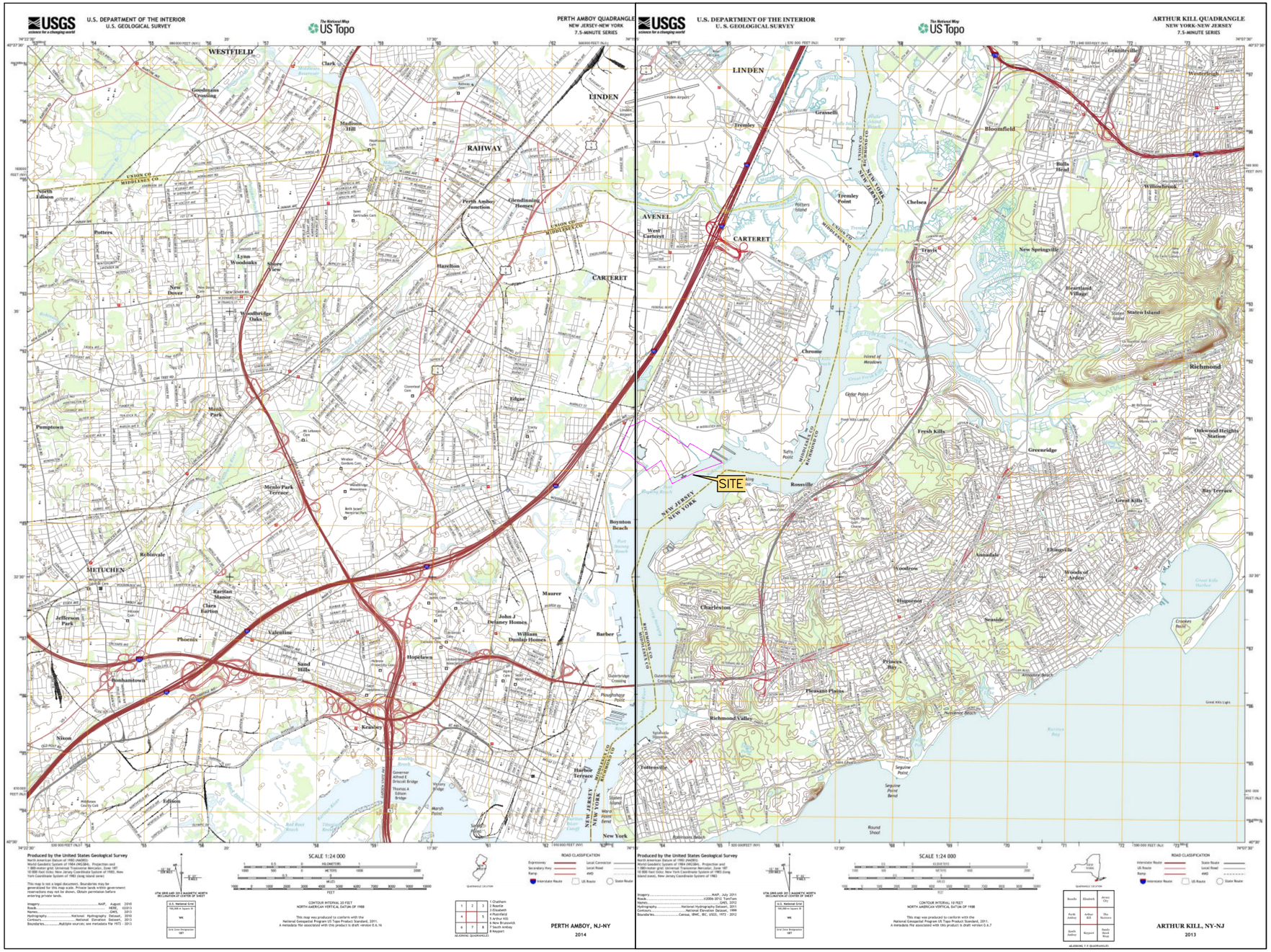
Pursuant to N.J.A.C. 7:1E-1.12 through 1.16 of the NJDEP TRSR, a Receptor Evaluation (RE) was prepared for the Site and submitted with the Site Investigation Report submitted in November 2015.

Pursuant to Chapter 7:26E-1.16 of the NJDEP TRSR, an Ecological Evaluation (EE) was conducted as part of the SI activities. An EE is a screening-level ecological risk assessment that serves to determine whether more rigorous ecological risk evaluations are warranted, and if so, to narrow the scope of subsequent activities. The EE conducted during 2015 SI activities concluded that an Ecological Risk Assessment (ERA) was required. Analytical data collected during the proposed AOC 103 investigation activities detailed in this plan will be incorporated into the ERA being prepared for the Site. The ERA will determine whether actual or potential ecological risks exist at the site and generate data for risk-based remediation goal determinations and for any Risk Management Decisions (RMD).

5.0 SCHEDULE

This SIW proposes investigation activities relating to AOC 103 – Fire Area/Fire Pits. In accordance with the NJDEP's Technical Requirements for Site Remediation, Hess will provide the NJDEP with 14 days' notice for all field activities prior to commencement of work. Hess is prepared to immediately implement the workplan pending approval by the NJDEP and EPA.

Figures



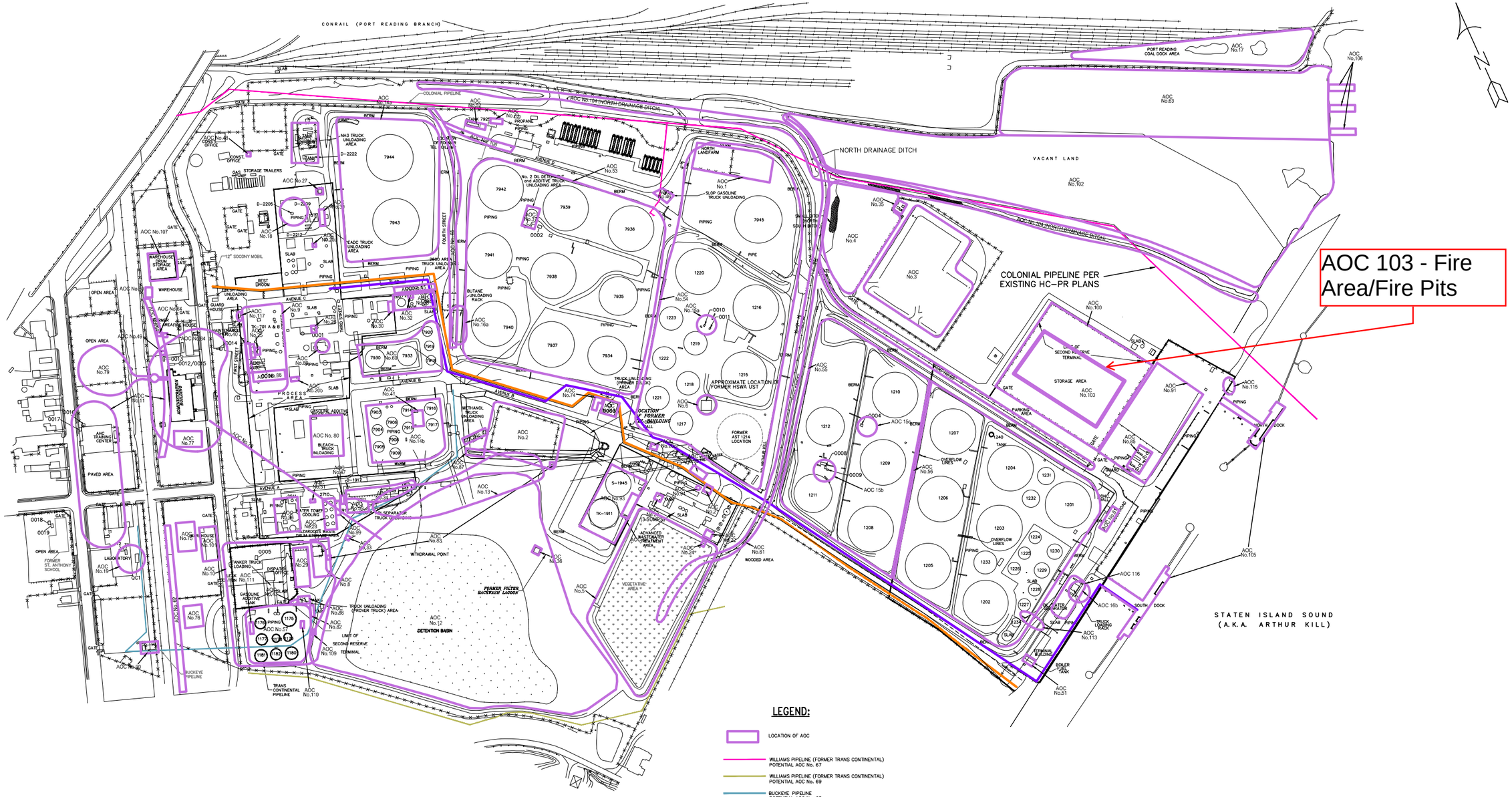
USGS MAP

Hess Corporation Former Port Reading Complex (HC–PR)
750 Cliff Road
Port Reading, New Jersey

Earth Systems

Figure 1

09/15 FIG1



LEGEND:

- LOCATION OF AOC
- WILLIAMS PIPELINE (FORMER TRANS CONTINENTAL) POTENTIAL AOC No. 67
- WILLIAMS PIPELINE (FORMER TRANS CONTINENTAL) POTENTIAL AOC No. 69
- BUCKEYE PIPELINE POTENTIAL AOC No. 68
- 12" SPECTRA PIPELINE (FORMER TEXAS EASTERN) POTENTIAL AOC No. 71
- 10"ABANDONED SPECTRA PIPELINE (FORMER TEXAS EASTERN) POTENTIAL AOC No. 70
- ABANDONED COLONIAL PIPELINE POTENTIAL AOC No. 7 / ACO. NO. 72
- UNKNOWN PIPELINE POTENTIAL AOC No. 112
- RAILROAD
- SURFACE WATER (Approximate)

0 200 400

(SCALE IN FEET)

NOTES:

1. AOC – AREA OF CONCERN
2. SWMU – SOLID WASTE MANAGEMENT UNIT
3. UST – UNDERGROUND STORAGE TANK
4. AST – ABOVE GROUND STORAGE TANK
5. AOC BORDERS WILL MODIFY IN ACCORDANCE WITH FIELD INVESTIGATION RESULTS
6. AOCs 97 ABOVE GROUND PIPING RUNS ARE NOT DEPICTED ON THIS FIGURE
7. AOCs 98 STORM&PROCESS SEWERS ARE NOT DEPICTED ON THIS FIGURE
8. * A HISTORIC AVERAGE DEPTH TO WATER WAS USED FOR TR-4DD TO GENERATE CONTOURS; GAUGED VALUE FOR 5/22/15 IS INCONSISTENT WITH PRIOR EVENTS AND ASSUMED ERRONEOUS.

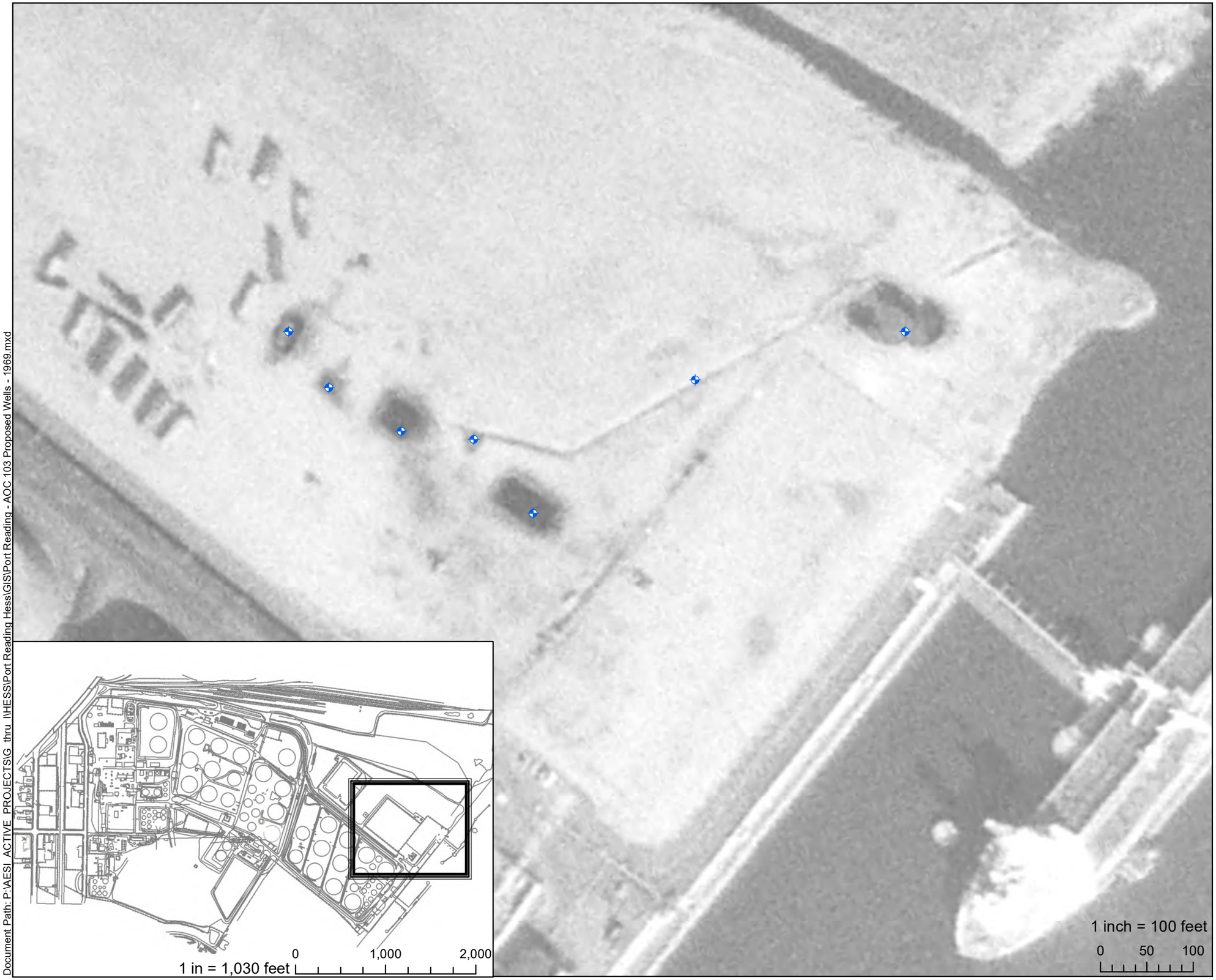
HISTORIC / POTENTIAL AREA OF CONCERN MAP

Hess Corporation Former Port Reading Complex (HC–PR)
750 Cliff Road
Port Reading, New Jersey

Earth Systems

Figure 2

09/15 FIG5



LEGEND

- AOC 103 Proposed Wells

N

Background image provided by:
Historic Aerials by NETRonline - www.historicaerials.com

FIGURE: 3
PROPOSED MONITORING WELL LOCATIONS
1969 HISTORIC AERIAL

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

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LEGEND

- AOC 103 Proposed Wells

N

FIGURE: 4

PROPOSED MONITORING WELL LOCATIONS RECENT AERIAL

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

This map was developed using New Jersey Department of Environmental Protection Geographic Information System Digital Data, but this secondary product has not been verified by NJDEP and is not state Authorized.
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

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LEGEND

- AOC 103 Proposed Wells

N

FIGURE: 5

PROPOSED MONITORING WELL LOCATION

AFFF Storage Area
(Buckeye)

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

This map was developed using New Jersey Department of Environmental Protection Geographic Information System Digital Data, but this secondary product has not been verified by NJDEP and is not state Authorized.
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

Appendix A

Earth Systems
Environmental Engineering

June 24, 2019

Via Certified Mail

Mr. Phil Cole
Bureau of Case Management
New Jersey Department of Environmental Protection
401 East State Street
PO Box 28
Trenton, New Jersey 08625-028

Mr. Andrew Park
Hazardous Waste Programs Branch
US Environmental Protection Agency Region 2
290 Broadway, 22nd Floor
New York, New York 10007-1866

Re: Response To Comments
AOC 103 – Fire Area/Fire Pits
Hess Corporation Former Port Reading Complex (HC-PR)
750 Cliff Road
Port Reading, Middlesex County, New Jersey
NJDEP PI# 006148
ISRA Case No. E20130449
EPA ID No. NJD045445483

Dear Mr. Cole & Mr. Park:

Earth Systems, Inc. (Earth Systems) has prepared this letter on behalf of Hess Corporation (Hess) to respond to the comments emailed by the New Jersey Department of Environmental Protection (NJDEP) on May 22, 2019 regarding the Site Investigation (SI) Workplan for Area of Concern (AOC) 103 – Fire Area/Fire Pits on the former Hess Port Reading Complex (Site). A teleconference was also held on May 22, 2019 to discuss the NJDEP comments.

A quarterly progress meeting with the NJDEP, USEPA, Hess, and Earth Systems was held on June 20, 2019 regarding the status of the Port Reading Site and AOC 103 was

also discussed during this meeting. Any applicable comments have been incorporated into this response.

NJDEP Comment/Question 1: Why didn't the LSRP of record select all of the Fire Fighting AOCs for investigation of potential AFFF (PFC) contamination to avoid these obvious delays?

Earth Systems/Hess Response 1: A pragmatic, best industry practice approach to site investigation activities is to target the known source areas with sampling efforts and then expand the investigation as data is collected and analyzed. The intent was to initiate the investigation of AFFF in known fire pits identified on historic aerials and through the interview of former personel familiar with the activities within AOC 103 and then, based on analytical findings, delineate impacts within AOC 103. Additional monitoring well locations have been added to address areas identified by the NJDEP (see attached **Figures 1** & **3**). These new proposed locations will be included in the revised SI Workplan.

NJDEP Comment/Question 2: Soils can be analyzed for PFCs that yield a quantitative result. Why didn't the LSRP of record include soil analysis as part of the Site Investigation?

Earth Systems/Hess Response 2: Soil analysis is not being conducted since current NJDEP guidance only requires a groundwater investigation. In addition, there are no promulgated soil standards to evaluate the analytical results against. An explanation of why soil sample analysis is not being conducted will be included in the SI workplan for clarification purposes. If soil guidance or standards are promulgated by NJDEP at some point in the future, a sampling plan will be prepared for these new requirements and submitted to NJDEP for approval prior to implementation.

NJDEP Comment/Question 3: Groundwater flow is speculative in the area of AOC 103, and the SI Workplan does not provide sufficient wells to determine correct groundwater flow directions.

Earth Systems/Hess Response 3: As explained above, additional monitoring wells are being installed to investigate areas identified by the NJDEP. Once the proposed new wells are installed and gauged, groundwater flow direction will be confirmed.

NJDEP Comment/Question 4: Why didn't the LSRP of record propose sufficient well placement to properly delineate the flow directions?

Earth Systems/Hess Response 4: There are currently over 80 monitoring wells located within the former Hess Port Reading Complex property. Groundwater flow direction is based on the data from current site wells and the presence of the Arthur Kill to the east. However, as mentioned by the NJDEP, there is the possibility of obstructions and preferential pathways for groundwater flow in the area; therefore groundwater flow direction will be confirmed during the RI phase.

The below are provided as talking points for the upcoming conference call.

NJDEP Comment/Question 5: Fire Training Areas: The first indication of a potential fire training area is in the 1963 aerial photo. Subsequent aerials (1969, 1970, 1972, 1974, 1977, 1979, 1980) show primary burn areas that are similar, three of which are included as proposed well locations. Two smaller areas between the three main areas are not proposed for sampling. The 1969 and 1970 photos show an additional area of concern near the corner of the North Ditch and Arthur Kill and a ditch from burn areas to the North Ditch that appear to be related to fire training activities. The 1972 photo shows an additional area within the area identified as AOC 91 on site AOC figures.

- The three larger fire training areas are targeted for sampling. The sampling plan does not reflect all areas of potential fire training activity or support activities, including the first area in the 1963 photo, two smaller areas between the primary areas (all photos but particularly distinct in the 1974 photo), the area closer to the waterways in the 1969 and 1970 photos, the ditch from the fire training area to the North ditch, and the area within the limits of AOC 91 in the 1972 photo.

- Clarify if fire training areas moved to a different location or ceased altogether, and AFFF delivery, storage, accidental release, fire response, etc. locations.

Earth Systems/Hess Response 5: Additional monitoring well locations have been added to address the darkened areas in aerial photos identified by the NJDEP (see **Figure 1)**. The proposed new locations will be included in the revised SI workplan.

Additional research will be conducted during the SI regarding historic releases/incidents on Site as well as past storage locations. The AFFF is currently stored in tanker trucks with secondary containment in the parking lot north of the administration building. An additional monitoring well is proposed downgradient of this location (see **Figure 3**) and will be added to the SI Workplan.

NJDEP Comment/Question 6: Fire Training Materials and Analytical Methods: The ITRC History and Use of Per- and Polyfluoroalkyl Substances (PFAS) guidance provide information on which materials were primarily used over time. ITRC Aqueous Film-Forming Foam (AFFF) guidance provide information on the types of fluorinated foams that contain PFAS. PFOS was the primary compound in firefighting foam in the 1960-70s, and is recognized in the Class B Aqueous Film-Forming Foam (AFFF) materials as "Legacy PFOS AFFF". Class B AFFs also include: alcohol resistant Aqueous Film Forming Foam (AR-AFFF), film-forming fluoroprotein foam (FFFP), Alcohol-Resistant Film Forming Fluoroprotein Foam (AR-FFFP), Fluoroprotein Foam (FP) and Alcohol-Resistant fluoroprotein foam (FPAR).

- Will the analytical method pick up all types of AFFFs as the AOC 103 fire training area use appears to have been discontinued between 1980 and 1986.
    - Electrochemical fluorination (ECF) process-PFAS mixtures dominated by PFAAs (perfluoroalkyl acids) – both perfluoroalkylsulfonate (PFSA)

and perfluoroalkyl carboxylate (PFCA) homologues. Production phased out in 2002. Can still be in inventory
    - Fluorotelomerization process-polyfluorinated compounds with lesser amounts of PFAAs. Current production limits PFAS.

- Method 537 Version 1.1 analytes:

Perfluorobutanesulfonate	375-73-5
Perfluorodecanoic acid	335-76-2
Perfluorododecanoic acid	307-55-1
Perfluoroheptanoic acid	375-85-9
Perfluorohexanesulfonate	355-46-4
Perfluorohexanoic acid	307-24-4
Perfluorononanoic acid	375-95-1
Perfluoro-octanesulfonate	1763-23-1
Perfluorooctanoic acid	335-67-1
Perfluorotetradecanoic acid	376-06-7
Perfluorotridecanoic acid	72629-94-8
Perfluoroundecanoic acid	2058-94-8

Earth Systems/Hess Response 6: Groundwater Quality Standards (GWQS) or Interim GWQS have been established for the compounds that were proposed for laboratory analysis in the SI Workplan (perfluorooctanoic acid – PFOA, perfluorooctanesulfonic acid – PFOS, and perfluorononanoic acid - PFNA). As per the ITRC AFFF fact sheet, AFFF manufactured between the 1960's to 2002 made by 3M contained PFOS and possibly PFOA; AFFF not made by 3M had components that break down to PFOA over time. Therefore, analysis of PFOA and PFOS is appropriate to determine potential impacts from historic use of AFFF. All analysis of groundwater samples will be conducted by a NJDEP certified and NELAC accredited certified laboratory. (SGS North America – Orlando, NJDEP Lab #FL002).

NJDEP Comment/Question 7: Sample Collection: ITRS Site Characterization Considerations, Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS) guidance, Section 3:

- Does the Sampling Plan/QAPP address all issues outlined in Section 3 (3.1 – 3.6)
    - Analytical method sample bottle specifications.
    - Analyze entire sample (including rinsate), particularly if anticipate low levels. If already know there is contamination, entire sample does not have to be used. If unknown, collect additional volume of each sample in a separate container – laboratory can screen the extra sample for high concentrations without affecting the final sample result.

Earth Systems/Hess Response 7: A NJDEP certified (SGS Orlando NJDEP Lab #FL002) and NELAC accredited laboratory is being utilized to conduct analysis of the groundwater samples. For informational purposes, a copy of the laboratory's method has been attached to this response. All groundwater sampling protocols will comply with the approved method (modified EPA 537).

NJDEP Comment/Question 8: Well Locations:

- How will wells be located: coordinates from aerials – NJ GeoWeb Easting/Northing coordinates?

  1974 Aerial (NJ GeoWeb) Fire Training areas:
  Easting: 564,387.24 Northing: 629,141.09
  Easting: 564, 406.56 Northing: 629,075.28
  Easting: 564,463.78 Northing: 629,010.18
  Easting: 564,516.00 Northing: 628,945.09
  Easting: 564,561,06 Northing: 628,867.12
  Easting: 564,968.8 Northing: 628,907.18 (area near North Ditch)

Earth Systems/Hess Response 8: Historic geo-referenced aerial photographs have been obtained and will be uploaded into GIS. Sampling locations will be selected in GIS by utilizing the features identified in historic aerials and the coordinates are used by field staff to locate the proposed sampling points. See **Figure 2** for the locations of the proposed wells in relation to current Site conditions.

NJDEP Comment/Question 9: Well Installation: Inert well construction material proposed: stainless steel.

Earth Systems/Hess Response 9: As discussed during the conference call, monitoring wells will be constructed utilizing PVC. This change will be reflected in the revised SI Workplan.

- **(9a)** Specify any pre-clearing methods. Geophysics should be proposed rather than any air knifing/vacuum extraction clearing methods.

Earth Systems/Hess Response 9a: As per Hess and Buckeye safety protocols, all boring locations are required to be pre-cleared to 6 or 8 feet below grade depending on their proximity to a known asset (pipelines, underground structures, tanks, etc.). Pre-clearing protocols include notification to NJ One Call, a private mark-out utilizing Ground Penetrating Radar (GPR) survey methods, and an evaluation of available as-built drawings of the Site. As discussed during the June 20, 2019 meeting, Earth Systems will attempt to hand auger to 6/8 feet below grade and then switch to a Geoprobe, especially in cases where soil samples will be collected for Volatile Organic Compound (VOC) analysis. This method allows for the least impact to the integrity of the sample results and for the appropriate logging of the shallow soil lithology. However, if hand augering is not possible due to field conditions, the boring locations will be pre-cleared using air knifing/vacuum extraction. We do not believe that the pre-clearing method will compromise well installation or sample collection.

As discussed during the June 20, 2019 meeting, Earth Systems will attempt to hand auger to 6/8 feet below grade and then switch to a Geoprobe, especially in cases where soil samples will be collected for Volatile Organic Compound (VOC) analysis. This method allows for the least impact to the integrity of the sample results and for the appropriate logging of the shallow soil lithology. However, if hand augering is not possible due to field conditions, the boring locations will be pre-cleared using air knifing/vacuum

extraction. We do not believe that the pre-clearing method will compromise well installation or sample collection.

- **(9b)** Depending on well installation method/formation disturbance, may need longer than 2 week stabilization period.

Hess/Earth Systems Response 9b: We request additional clarification regarding this point. The standard method is to collect groundwater samples two weeks after monitoring well installation. Please clarify why sampling for PFOAs would require additional stabilization time.

- **(9c)** Specify drilling and logging methods:
  - Continuous split spoon sampling from within each the burn areas to characterize fill and the depth of the burn pits, and the location of the original tidal marsh sediments/meadow mat. Field screening observations, soil characteristics, moisture content and depth to water are to be provided on the boring log.

Earth Systems/Hess Response 9c: A boring log will be prepared for each monitoring well installation documenting the observed lithology and any field observations, such as depth to water.

  - **(9d)** Surrounding ground surface elevations are 8-10' msl (PER-8 and No. 1 landfarm wells) so wells may be shallower than 15' to be completed in first water and above the meadow mat/organic silts-clays.
  - **(9e)** Locate the well screen across the water table if possible. If not, minimize the length of casing as much as possible.

Earth Systems/Hess Response 9d & 9e: The monitoring wells will be installed to a depth that will ensure sufficient groundwater volume for sample collection. We anticipate that the groundwater wells will be shallow and likely no deeper than 15 feet below grade based on information accumulated through the installation of the 80 wells currently on Site. Each well will be constructed with the well screen across the water table.

- **(9f)** Tailor well screen slot size and sand pack to the formation characteristics to minimize sample turbidity.
- **(9g)** Specify well development method.

Earth Systems/Hess Response 9f & 9g: The monitoring wells will be installed by a licensed well driller and will be constructed and developed in accordance with best practices/methods.

- (9h) Drill cuttings, well development, purge water and decontamination water management pending ground water sample result evaluation.

Earth Systems/Hess Response 9h: All drill cuttings, development water, and purge water will be drummed for offsite disposal.

NJDEP Comment/Question 10: Ground Water Purge and Sample Procedures:

- Sampling protocol focuses on materials to use/not use, not sampling procedures.
- Appears to be a volume average sample method? See FSPM Section 6.9.2.4. Identify pump type (shallow wells) and pump deployment depth (relative to the water table and top of screen) for purge. Identify observations to monitor and limit drawdown/adjust pump. Record pump rate, DTW and time at purge start, during, and end of purge; DTW and time at start of sampling and end of sampling.
- Keep purge rate less that the well yield identified at well development. Identify sample collection methods.
- If same pump is used at each well, identify field decontamination procedures and final rinse with laboratory certified PFAS free water.

Earth Systems/Hess Response 10: Three volumes of groundwater will be purged from each monitoring well prior to collecting a groundwater sample. A peristaltic pump will be used for well purging since the polyethylene tubing can be changed out between each well. No other parts of the peristaltic pump come into contact with the groundwater; therefore, decontamination of the pump is not necessary. A new polyethylene bailer will be used to collect a groundwater sample from each of the monitoring wells. The monitoring well will be purged at a rate to minimize well drawdown and turbidity. Groundwater levels will be monitored during well purging and the flow rate adjusted if necessary. The groundwater sampling methodology will be detailed in the revised SI Workplan.

NJDEP Comment/Question 11: Additional Analyses:

- Ground water geochemistry (e.g., TOC, TDS, chloride) and other applicable COCs (VOC, SVOC, EPH).
- Field sampling parameters: pH,

Hess/Earth Systems Response 11: The groundwater samples collected from the proposed wells will be analyzed for TOC, TDS, chloride, VOCs, and SVOCs as well as PFOA, PFOS, and PFNA by a NJDEP certified and NELAC accredited laboratory (SGS NJ #12129, SGS Orlando – FL002). 'Analyze immediately' parameters (including pH) will be recorded in the field during well purging.

NJDEP Comment/Question 12: PFAS QAPP: Evaluate laboratories ability to meet project goals, analytical procedures, performance data (lab blanks and matrix spike recovery) and identify PFAS of concern.

- Available Criteria:
  Perfluorononanoic Acid (PFNA): GWQS 13 ppt
  Perfluorooctanesulfonate (PFOS): Interim GWQS 10 ppt
  Perfluorooctanoic acid (PFOA): interim GWQS 10 ppt
  EPA Guidance level: PFOA+PFOS: 70 ppt
  Total PFAS: 500 ppt

Hess/Earth Systems Response 12: The laboratory selected is both NJDEP and NELAC certified (SGS Orlando Lab #FL002) and can meet the appropriate method detection limits for PFOA, PFOS, and PFNA (modified EPA method 537).

NJDEP Comment/Question 13: Ground Water Data Evaluation:

- The Department does not concur at this time that, if PFAS are not identified in ground water, that no further investigation is required (page 4).
- The presence of PFAS will result in further evaluation of impacted media and receptors.

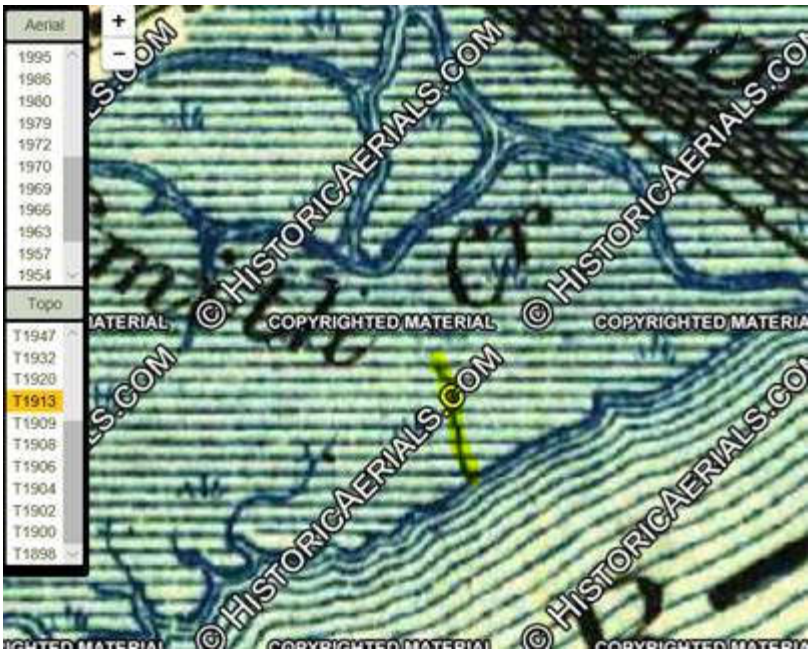
Hess/Earth Systems Response 13: Additional proposed monitoring well locations have been added to the SI Workplan. Once groundwater samples are collected from all proposed monitoring wells, the analytical results will be provided to the NJDEP and EPA for review. Earth Systems/Hess will also provide a recommendation on whether additional Remedial Investigation activities are required as per the regulations and available guidance.

If PFAS are detected in the groundwater samples, further evaluation of potentially impacted media and receptors will be conducted.

NJDEP Comment/Question 14: Conceptual Site Model for PFAS Distribution - Setting:

The fire training area is adjacent to the Second Reserve Tankfield (AOC 56). This area is a filled wetland. Historic topo maps do not reflect former tidal streams into the fire training area, but former tidal streams in proximity to the area may continue to influence flow conditions. The land area fronting this part of the site had bulkhead construction between 1963 and 1966. A petroleum product transmission line passes through the area between AOC 56 and the North Ditch.

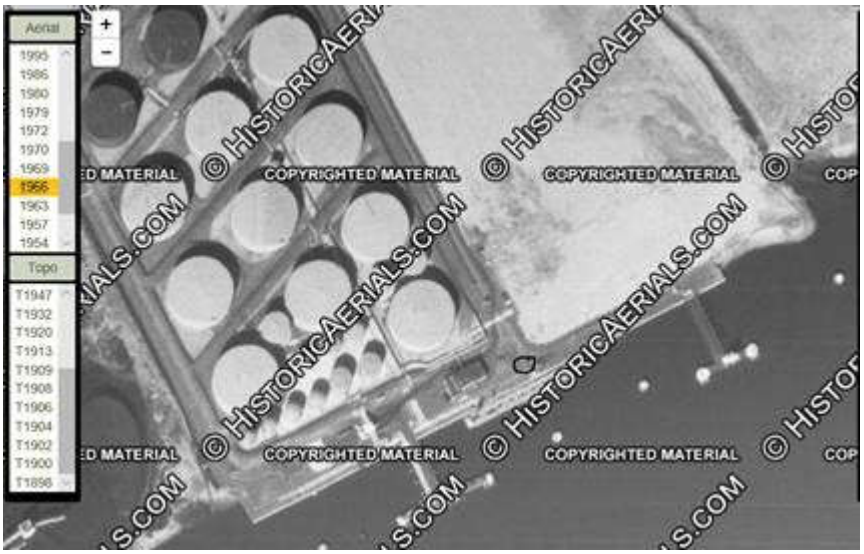
- **(14a)** Ground water flow conditions are not well defined and there are multiple potential influences on flow including but not limited to: tidal fluctuations, heterogeneous fill, North Ditch, former (filled) tidal streams, Colonial Pipeline location, Bulkhead-Phase 1 (terminal area at the Second Reserve Tankfield) and Bulkhead-Phase 2 (at the edge of AOC 91) construction and tie in to land area, etc. The highlighted former tidal stream is within the limits of the Second Reserve Tankfield (AOC 56).



- **(14b)** The following two photos show the progression of the bulkhead construction. Unknowns include bulkhead construction, how the bulkhead is tied into the upland area, the connection between Phase 1 and Phase 2, and fill behind the bulkhead. Depending on construction, bulkheads can result in mounding conditions that reverse flow away from the water way to a discharge point around the edges of the bulkhead. PER-8 is at the eastern corner of the bulkhead-phase 1. Bulkheads can dampen tidal influence.

Hess/Earth Systems Response 14a & 14b: Once the proposed SI monitoring wells are installed and sampled, the analytical data will be reviewed to determine if additional delineation is required. If additional groundwater delineation is required, site specific information (preferential pathways, area obstructions, etc.) will be included in the evaluation of potentially impacted areas and the placement of additional groundwater monitoring wells. If, at the conclusion of the SI it is determined that additional remedial

investigation is necessary, all RI activities will be approved by the NJDEP and EPA prior to initiation of the RI phase.



- **(14c)** What is present surface cover in former burn areas, or burn influenced areas?

Earth Systems/Hess Response 14c: The surface is currently paved in the former burn areas identified in the SI Workplan. The surface is vegetated in the additional areas identified by the NJDEP located to the east of the former burn areas.

- **(14d)** Was runoff from any fire training areas, AFFF storage areas, AFFF release or emergency response use areas, etc. connected to or managed at the storm water control system, API Separator, Detention Pond and/or WWTP?
- **(14e)** When were North Ditch and tidal flat dredged.
- **(14f)** Air transport during application/training to surrounding areas.

Earth Systems/Hess Response 14d, 14e, & 14f: Additional research will be conducted regarding the above points as part of the proposed SI activities.

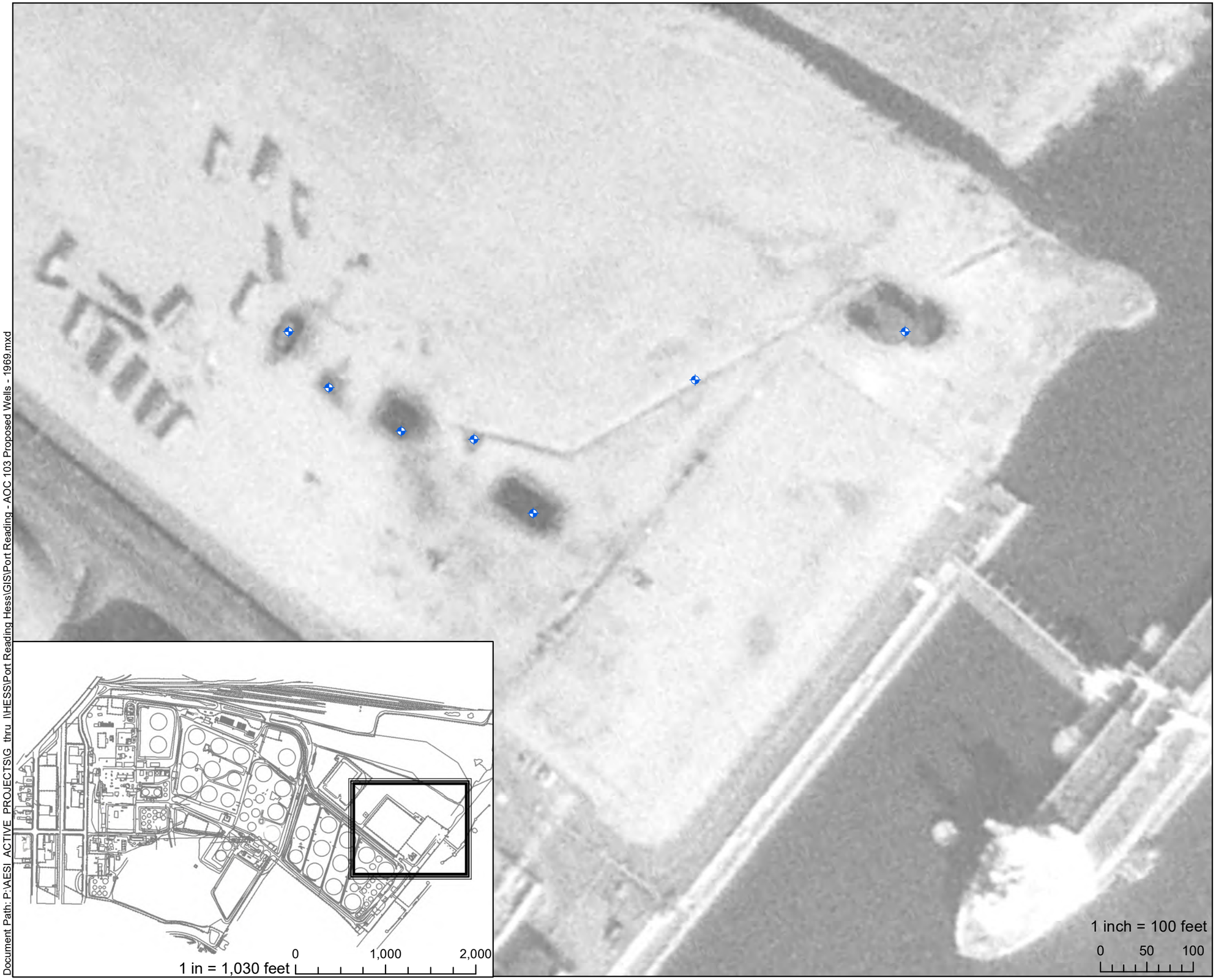
Should you have any questions or require additional clarification or information, please contact me at 732-739-6444 or via e-mail at ablake@earthsys.net. If you have any questions relating to the project and schedule moving forward, you can also contact Mr. John Schenkewitz of Hess Corporation at 609-406-3969.

Sincerely,

Earth Systems, Inc.

Amy Blake
Sr. Project Manager

c. Mr. John Schenkewitz – Hess Corporation (via e-mail)
Mr. Rick Ofsanko – Earth Systems (via e-mail)
Mr. John Virgie – Earth Systems (via e-mail)



LEGEND

- AOC 103 Proposed Wells

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Background image provided by:
Historic Aerials by NETRonline - www.historicaerials.com

FIGURE: 1
PROPOSED MONITORING WELL LOCATIONS
1969 HISTORIC AERIAL

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

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LEGEND

- AOC 103 Proposed Wells

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FIGURE: 2

PROPOSED MONITORING WELL LOCATIONS
RECENT AERIAL

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

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This map was developed using New Jersey Department of Environmental Protection Geographic Information System Digital Data, but this secondary product has not been verified by NJDEP and is not state Authorized.
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

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LEGEND

- AOC 103 Proposed Wells

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FIGURE: 3

PROPOSED MONITORING WELL LOCATION

AFFF Storage Area

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	6/14/2019
SRP PI#:	006148	**Drawn By:**	RC

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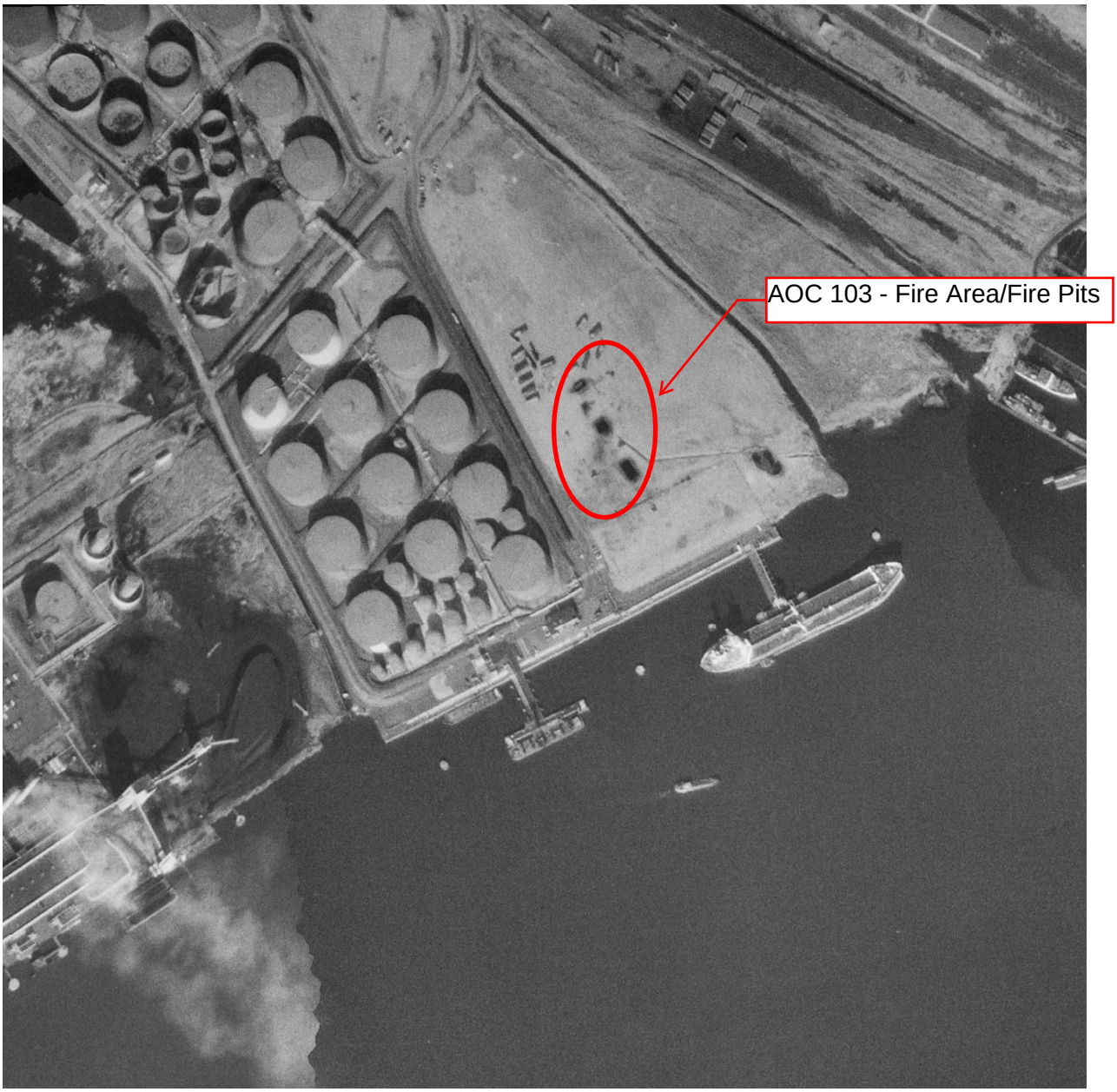
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

Appendix B

1969 Historical Aerial Photograph
750 Cliff Road
Port Reading, New Jersey



1979 Historical Aerial Photograph
750 Cliff Road
Port Reading, New Jersey

Appendix C

(Electronic Copy Only)

QUALITY ASSURANCE PROJECT PLAN

AOC 103 – FIRE AREA/FIRE PITS
Hess Corporation – Former Port Reading Complex (HC-PR)
750 Cliff Road
Port Reading, Middlesex County, New Jersey
NJDEP PI# 006148
ISRA Case No. E20130449
EPA ID No. NJD045445483

PREPARED FOR:

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West Trenton, New Jersey 08628

PREPARED BY:

Earth Systems

September 2019

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Table of Contents

INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared by Earth Systems, Inc. (Earth Systems) for Hess Corporation, who is conducting site investigation (SI) activities at the environmental area of concern designated as AOC 103 – Fire Area/Fire Pits located at 750 Cliff Road, Port Reading (Woodbridge Township), Middlesex County, New Jersey (Property or site).

The purpose of this QAPP is to ensure that scientific data are acquired according to established methods and procedures designed to obtain results that are objective, true, repeatable, and of known accuracy. Specifically, this QAPP provides guidance and specifications to ensure that SI activities are planned and executed in a manner consistent with the Quality Assurance Objectives (QAO's) stated below:

- Field determinations and analytical results are valid through adherence to New Jersey Department of Environmental Protection (NJDEP) field procedures, NJDEP-approved analytical protocols, and calibration and preventive maintenance of equipment;
- Samples are identified and controlled through sample tracking systems and chain of custody procedures;
- Records are retained as documentary evidence of field activities and observations;
- Samples are collected and analytical data are validated in accordance with the NJDEP requirements; and
- Evaluations of the data are accurate, appropriate, and consistent throughout the project.

The contents of this QAPP are based on the NJDEP requirements as stated in the NJDEP Technical Requirements for Site Remediation and the Quality Assurance Project Plan Technical Guidance (Version 1.0, April 2014). This QAPP includes the following components:

- Problem Definition/Background;
- Project/Task Description;
- Project/Task Organization;
- Data Quality Objectives and Criteria for Measurement Data;
- Historical and Secondary Information/Data;
- Investigative Process Design;
- Field Instrumentation/Equipment Calibration and Frequency;
- Inspection/Acceptance of Supplies and Consumables;
- Sample Handling and Custody Requirements;
- Field Storage and Transport Procedures;
- Sample Containers, Preservation, and Holding Times;
- Analytical Methods Summary Table;
- Project Compounds and Analytical Summary;
- Analytical Quality Control;
- Laboratory Deliverables;
- Data and Records Management;
- Data Verification and Usability; and
- Corrective Action Processes.

As specific conditions and additional information warrant, this QAPP will be amended or revised to include site-specific quality assurance/quality control procedures.

1. Project Definition / Background

Project Definition

The property is owned by Hess Corporation and is located at 750 Cliff Road, Port Reading, New Jersey. HC-PR began operations on the Site in 1958. As part of safety training activities conducted during Hess' operation of the refinery, fires were set and extinguished using water or AFFF, which potentially contained PFAS. Based upon a review of historic aerials and discussions with Hess personnel, the location of the fire training area (AOC 103) was identified in the northeastern corner of the Site. This area was undeveloped/unpaved and was utilized as a fire training area from the 1960's to the 1980's.

The overall project goals and objectives are summarized below:

- Groundwater investigation to determine if PFAS are present at concentrations in excess of the interim GWQS

The analytical data shall be used to determine if further investigation or remediation is required. These decisions shall be made following receipt of all analytical data associated with the investigation. Data users for the project include the person responsible for conducting the remediation, the environmental consultant, and ultimately, the NJDEP.

2. Project / Task Description

As per the NJDEP issuance of "Site Remediation & Waste Management Program Implementation of March 13, 2019 Interim Specific Groundwater Quality Standards," a determination must be made for all Sites on whether PFAS were used, stored, or discharged at a Site. The former fire training area (AOC 103) was identified as part of the historical review of the Site. Therefore, there is a possibility that AFFF containing PFAS was used as part of fire training activities conducted at AOC 103.

A total of eight (8) groundwater monitoring wells will be installed to determine if PFAS are present in area groundwater. Groundwater samples will be collected from the wells two weeks after their installation utilizing a 3-volume purge method. Well construction details will be recorded on the well log and purge sheets. The volume purged, purge rate, temperature, pH, ORP, specific conductivity, turbidity, dissolved oxygen, and depth to water will be recorded during the purging process. The purge rate will be monitored to limit drawdown.

PFAS are potentially found in equipment typically used to collect groundwater samples. Therefore, disposable polyethylene (poly) tubing will be used to purge each well and poly bailers will be used to collect the groundwater samples. A peristaltic pump will be used to purge the wells. The depth of the pump placement will depend on the depth to groundwater but will be placed approximately 2-3 below the water table. The following table details the current acceptable sampling protocol.

Sampling Protocol	
Do Not Use/Avoid Contact With	**Do Use**
Teflon	High-density polyethylene (HDPE)
Fluoropolymer-containing materials	Single use/disposable polyethylene or silicone equipment (tubing, bailers)
Passive diffusion bags	Positive displacement/submersible pumps with no Teflon or polytetrafluoroethylene (PTFE) components
Low-density polyethylene (LDPE)	
Waterproof/treated paper or field books, Post-its, Waterproof ink or markers, Plastic Clipboards	Loose plain paper, metal clipboards, ballpoint pens
Adhesives	
Sample Technician on the day of sampling – no cosmetics, moisturizers, hand cream, insect repellant, other personal care products containing surfactants, sunblock	Sample Technician on the day of sampling – long-sleeved, light-colored 100% cotton shirts, wide-brimmed hats, tuck pants into socks as an alternative. Sunblock and insect repellants with 100% natural ingredients acceptable
Sample Technician on the day of sampling – no aluminum foil, pre-packaged foods, fast food wrappers/containers	
Sample Technician on the day of sampling - no Gore-Tex, water or stain resistant, Coated Tyvek, clothes laundered with fabric softener, treated boots (waterproof, water resistant, stain resistant)	Sample Technician on the day of sampling - cotton clothes laundered at least six times since purchasing without fabric softener, new nitrile gloves (replace frequently), Polyurethane or wax-coated rain gear (if needed), Polyurethane and polyvinyl steel-toed boots, Tyvek Suits
Sample Bottles & Glassware	
Do Not Use/Avoid Contact With	**Do Use**
LDPE	HDPE
Glass	Polypropylene
Teflon lined caps	HDPE or polypropylene caps
Methanol	Zip Loc Bags (Field Screening)
Sample Preservation- Transportation	
Do Not Use	**Do Use**
Chemical Ice Packs (i.e., Blue Ice)	Regular Ice/Zip Loc Bags
Decontamination Supplies Equipment	
Do Not Use	**Do Use**
Decon 90	Alconox or Liquinox
	Potable water, followed by PFAS free water rinse provided by laboratory and/or drilling contractor

All data shall be collected through groundwater sampling and laboratory analysis. No data shall be collected from other sources. The sample results shall be compared to the applicable remediation standards and a conclusion shall be made, based on the comparison, as to whether the Areas of Concern (AOCs) require further investigation / action or no further investigation / action is required.

The applicable regulatory quality standards to this phase of investigation are:

- NJDEP Interim Groundwater Quality Standards

3. Project / Task Organization

The NJDEP's "Quality Assurance Project Plan Technical Guidance" recommends that the QAPP include an organizational chart identifying key personnel and/or organizations showing relationships and lines of communication. As stated in Section 5 of the guidance, not all elements of the QAPP may need the same level of detail, which should be based on a graded approach depending on the complexity of the project and the intended use of the data. In this regard, since the number of personnel and organizations is relatively small, the relationships can be described rather than depicted in a chart.

Project Team

The Licensed Site Remediation Professional (LSRP) is John Virgie of Earth Systems. He also serves as the central point of communication with all other individuals and organizations associated with this project. He is responsible for implementing the Quality Assurance Project Plan and coordinating the site investigation activities. He can be reached at (732) 739-6444, extension 2306.

The Project Director and On-Site Health and Safety Officer for Earth Systems is Mr. Michael Piegaro. He can be reached at (732) 739-6444, extension 2309.

The Project Manager is Ms. Amy Blake of Earth Systems. She is responsible for coordinating the investigation and remediation activities in the field and tabulating/interpreting the analytical data once received. She can be reached at (732) 739-6444, extension 2305.

Laboratory: SGS-Accutest Laboratories, 2235 US Route 130, Dayton, NJ 08810 (Contact: Beth Wasserman @ 732-329-0200), SGS North America Orlando, 4405 Vineland Rd, Orlando, FL

Drilling Contractor: Uni-Tech Drilling Company, 49 Old York Road, Bridgewater, New Jersey 08807 (Contact: Greg Adams @ 908-725-7500)

Special Training Needs/Certification

Training needs and certifications of field oversight include requirements to have completed the OSHA 40-Hour training with annual 8-hour refresher training in accordance with 29 CFR 1910.120 (Hazardous waste operations and emergency response). In addition, site workers must have a TWIC card and at least one person on-site must have completed Buckeye Person-In-Charge (PIC) training.

The investigation activities are being conducted under the oversight of an LSRP.

Special training is required to operate laboratory equipment and conduct laboratory analyses. Laboratory certification is established at N.J.A.C. 7:18.

4. Data Quality Objectives and Criteria for Measurement Data

Data quality objectives ("DQOs") are qualitative and quantitative statements that are developed in the first six (6) steps of the DQO process. DQOs define the purpose of the data collection effort, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data.

In accordance with Section 5.4 of the NJDEP's "Quality Assurance Project Plan" technical guidance, the development of the data quality criteria can be developed through the formal DQO process described in the EPA document titled "Guidance for the Data Quality Objectives Process", EPA/600/R-96/055. For most projects, however, a less iterative process is normally used to develop the project-specific DQOs.

Data of Known Quality Protocols ("DKQP") describe specific laboratory quality assurance and quality control procedures which, if followed, will provide data of known and documented quality (i.e. scientific reproducible and reliable data). When data of known quality ("DKQ") is obtained, an evaluation of the data with respect to its intended purpose can be made. To this end, a NJDEP-certified laboratory must be used to analyze samples whenever possible.

Typical DQOs are often expressed in terms of data quality indicators ("DQIs") including precision, accuracy, representativeness, comparability, completeness and sensitivity (also known as the "PARCCS" parameters). These measures of performance are discussed in detail below.

<u>Precision</u>
Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar testing conditions. The investigator will determine the precision of the data by:

- Using the same analytical methods to perform repeated analyses on the same sample (laboratory or matrix duplicates);

Precision for laboratory and field measurements can be expressed as the relative percent difference ("RPD") between two duplicate determinations or percent relative standard deviation ("%RSD") between multiple determinations.

The resulting information will be used to assess sample homogeneity, spatial variability at the site, sample collection reproducibility, and analytical variability.

<u>Accuracy</u>
Accuracy is the degree of agreement of a measured value and an accepted reference or true value. The difference between the measured value and the reference or true value includes components of both systematic error (bias) and random error (precision). It should be noted that precise data may not be accurate data. Accuracy can be expressed as a percent recovery or percent deviation of the measurement with respect to its known or true value.

The accuracy will be determined through establishing acceptance criteria for spike recoveries (e.g., surrogate recoveries, laboratory control sample recoveries, matrix spike recoveries, reference material

recoveries etc.) or allowable deviations for calibration (e.g., %RPD for calibration verification). Acceptance criteria for matrix spike measurements are expressed as a percent recovery and are usually specified in the analytical method (or laboratory SOP, as applicable). Various blank samples (laboratory or field) may also be used to assess contamination of samples that may bias results high. Accuracy in the field shall be assessed through the adherence to sample collection, handling, preservation, and holding time requirements.

Representativeness

Representativeness is a qualitative measurement that describes the extent to which analytical data represent the site conditions. In almost every project, the investigator will not be able to measure the whole system, process, or situation of interest. Instead, the investigator will choose sample locations, quantities, and analyses in order to capture a sufficiently broad and/or weighted view of the situation.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample holding times. Following the detailed requirements outlined in the EPA methods and the laboratory SOPs will maximize the representativeness of the laboratory data.

Comparability

Comparability is a qualitative term that expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Comparability is defined as the extent to which data from one data set can be compared directly to similar or related data sets and/or decision-making standards.

Historical data should be evaluated to determine whether they may be combined with data being collected in present time. Comparability should discuss comparisons of sample collection and handling methods, sample preparation, and analytical procedures, holding times, stability issues and QA protocol.

Comparability in the laboratory is dependent on the use of recognized methods and approved laboratory SOPs. Comparability in the field is dependent upon adherence to the sampling methodology and that the proper preservation techniques are used.

Completeness

Completeness is a measure of the amount of usable data collected compared to the amount of data expected to be obtained. Three measures of completeness are defined as:

- Sampling completeness, defined as the number of valid samples collected relative to the number of samples planned for collection;
- Analytical completeness, defined as the number of valid sample measurements relative to the number of valid samples collected; and
- Overall completeness, defined as the number of valid sample measurements relative to the number of samples planned for collection.

Sensitivity

Sensitivity refers to the ability of an analytical procedure to quantify an analyte at a given concentration. The sensitivity requirements should be established such that the laboratory method Reporting Limits ("RLs") are at or below the relevant and applicable regulatory limits for each Contaminant of Concern ("COC") for the project. For the purpose of SRP projects:

- The RL for a specific substance when determining the extent and degree of polluted soil, groundwater, or sediment from a release. For the purpose of this document, the RL is defined as:
  - Organics, the lowest initial calibration standard as adjusted for the dilution factor, sample weight/volume, and moisture content;
  - Inorganics, the concentration of that analyte in the lowest level check standard (which could be the lowest calibration standard in a multi-point calibration curve).

Methods for analysis have been chosen to meet the sensitivity requirements for a project (e.g., compound-specific and matrix-specific). If however, the laboratory RLs exceed the project sensitivity requirements (i.e., the RL is above the relevant and applicable regulatory standard), the analytical methods may need to be adjusted (e.g., analysis conducted using a more sensitive method or sample preparation and analysis features adjusted to gain sensitivity) and/or the project objectives may need to be adjusted (i.e., certain COCs may not be able to be screened out during this phase of the evaluation).

5. Historical and Secondary Information / Data

The potential sources of data for any project include both historical data (i.e. data not collected by the current investigator) and secondary data (i.e. data that were collected for a different purpose than that for which they are now being used). Historical data should be evaluated for applicability to current project objectives. Secondary data should be assessed to determine if the quality of the data is sufficient for the current project objectives and meets comparability criteria (it is not sufficient that the secondary data were produced by a reliable source or a known environmental monitoring project with an approved QAPP).

6. Investigation Process Design

A description and justification of the investigation design should include, for each area of interest:

- The COCs or other parameters of interest
- The number of anticipated investigation points and how and why they will be selected including a site map depicting proposed sample locations
- Method of obtaining/determining locational information (such as the use of GPS instrumentation)
- Factors which could affect the variability of the data such as physical obstructions, seasonal variations, tidal influences, soil profile changes, weather-related variation, and process variation within the source
- Design basis i.e. probability based or judgment based
- Results comparison (i.e. versus previous data, regulatory standards, reference population, etc.)
- Matrices to be monitored including any special sampling requirements
- Monitoring frequency (if applicable)
- Heterogeneity or homogeneity of the matrix
- Appropriateness of composite samples
- Required quality control samples

The investigative process design is based generally on the following:

- The Technical Requirements for Site Remediation N.J.A.C. 7:26E.
- The NJDEP's "Field Sampling Procedures Manual (FSPM)" dated August 2005.

7. Field Quality Control

Field equipment cleaning / decontamination are not expected to be required as all field equipment shall be dedicated to each individual sample.

8. Field Instrumentation / Equipment Calibration and Frequency

Field instrumentation/equipment that will require calibration include a photoionization detector (PID) and water quality meter (Horiba U52). Calibration and routine maintenance procedures are presented in the User's Manual. Documentation of the maintenance and calibration records are stored at the office or in the field logbook.

9. Inspection / Acceptance of Supplies and Consumables

Critical supplies or consumables (e.g., pre-cleaned containers, pre-preserved containers, tubing, etc.) shall be inspected for visible indications of contamination and damage and, if none are identified, then the supplies/consumables shall be accepted for use.

10. Sample Handling and Custody Requirements

Sample handling shall be as specified in Section 2.5.5.1 of the FSPM and Section 4.6.2.2 of the NJDEP's "Data Quality Assessment and Data Usability Evaluation Technical Guidance", Version 1.0, dated April 2014. Specifically, samples shall be maintained on-site for no more than two (2) consecutive days and shall be delivered to the laboratory within one (1) day of shipment from the field.

The chain of custody procedure to be utilized in the field is specified in Section 2.3.6 of the FSPM. The chain of custody procedure to be used in the laboratory shall be in accordance with Section 2.3.6 of the FSPM as well as the laboratory's standard operating procedure.

11. Field Storage and Transport Procedures

Samples shall remain in direct sight and in the custody of field personnel at all times until transfer to the laboratory.

12. Sample Containers, Preservation, and Holding Times

Sample containers, preservation, and holding times are specified on Table 1.

13. Analytical Methods Summary Table

Analytical methods are summarized on Table 1.

14. Project Compounds and Analytical Summary

Groundwater samples will be collected and analyzed for PFAS. The project action limits are the NJDEP's Interim Groundwater Quality Standard. The analytical methods chosen can meet the DQOs of the project.

Analytical sensitivity requirements include the use of instruments or methods to detect the contaminants of concern at or below the action limits. The RLs are expected to be below the applicable regulatory standards. NJDEP and EPA methods were selected to achieve the action limits. Laboratories may need to adjust RLs based on dilutions, sample sizes, extract/digestate volumes, percent solids and cleanup procedures. Sensitivity will be maximized by following the NJDEP and EPA methods or laboratory SOPs utilizing experienced, trained laboratory personnel and by conducting laboratory audits.

15. Analytical Quality Control

Quality assurance and quality control ("QA/QC") requirements for analysis are specified in the most recent version of the document titled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", prepared by EPA. The laboratory may also have QA/QC procedures in addition to those specified by the test method (Appendix 1).

16. Laboratory Deliverables

The laboratory deliverable format to be used for this project shall be the reduced laboratory deliverable format as described in Appendix A of N.J.A.C. 7:26E. The laboratory shall also generate Hazsite files and spreadsheets of the analytical results.

17. Data and Records Management

The recording media for the project will be both paper and electronic. The project will implement proper document control procedures for both, consistent with NJDEP's Quality Management Plan. For instance, hand-recorded data records will be taken with indelible ink, and changes to such data records will be made by drawing a single line through the error with an initial by the responsible person. The Project Manager will have ultimate responsibility for any and all changes to records and documents. Similar controls will be put in place for electronic records.

The Quality Assurance Coordinator shall retain all updated versions of the QAPP and be responsible for distribution of the current version of the QAPP. The Quality Assurance Coordinator and the Project Manager will approve periodic updates. The Project Manager shall retain copies of all management reports, memoranda, and all correspondence between the parties identified in Section 3.

Project data shall be stored in the Project Manager's office. Laboratory records management is described in Appendix 1.

18. Data Verification and Usability

The procedure for review (verification and usability procedures) including data assessment versus stated data quality objectives of the investigation is specified in the NJDEP's "Data Quality Assessment and Data Usability Evaluation Technical Guidance", Version 1.0, dated April 2014.

19. Corrective Action Processes

Corrective action in the field may be needed when the work plan is modified (i.e. number or locations of samples) or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. The corrective action may be implemented at the time the determination is made in the field or may be implemented later, depending on the circumstances. Any corrective actions taken shall be documented in the field logbook and in the technical report.

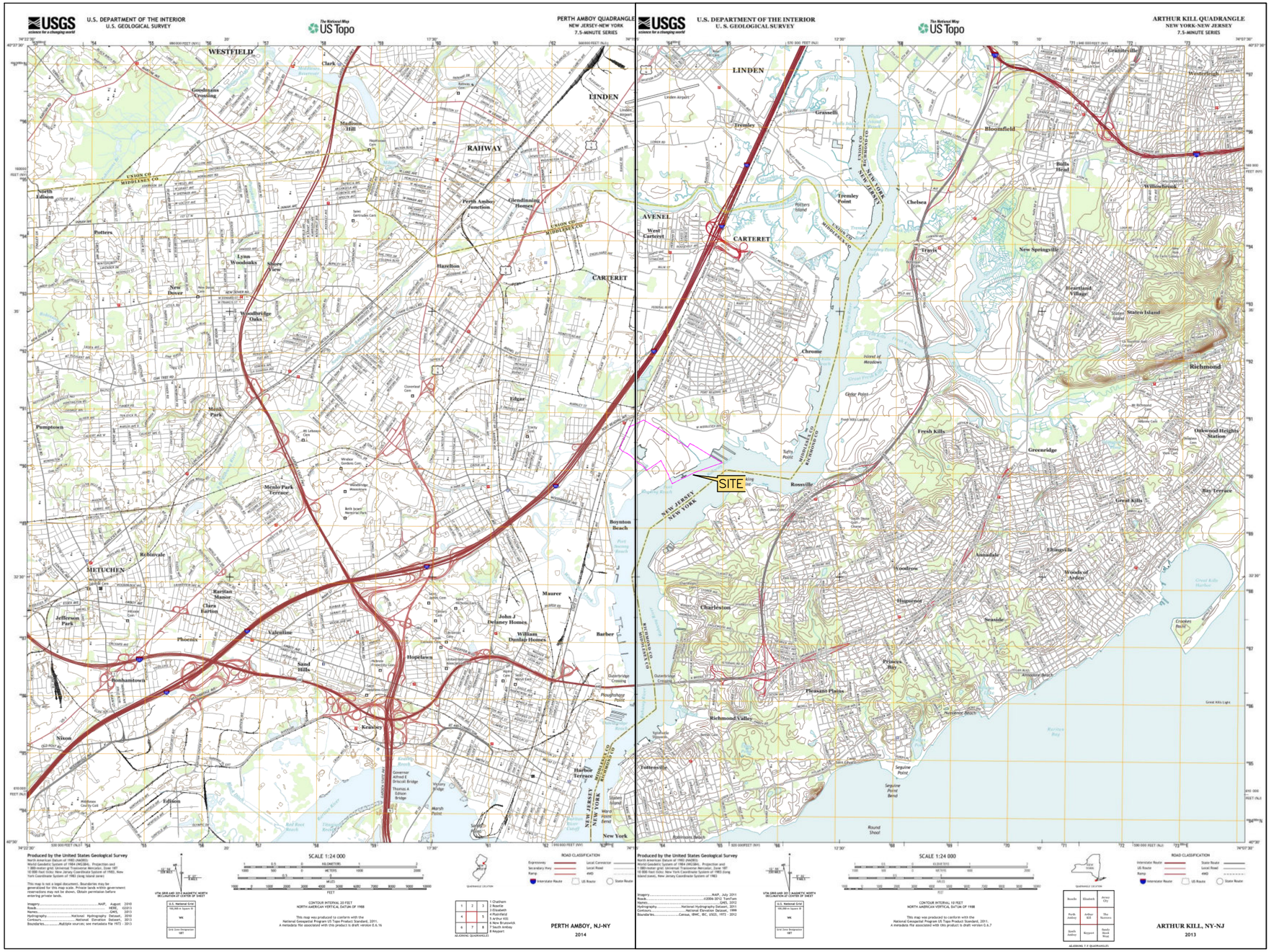
Corrective actions in the laboratory may be needed when Non-Conformances occur. The laboratory shall implement and document corrective actions in accordance with the laboratory SOP.

Table 1: Analytical Methods / Quality Assurance Summary Table

TABLE 1
Analytical Methods/Quality Assurance Summary Table
AOC 103 – Fire Area/Fire Pits, Hess Corporation – Former Port Reading Complex, Port Reading, Middlesex County, New Jersey

Matrix	Number of Samples	Blanks	Duplicates	Analytical Parameters	Sample Method	Temperature	Sample Volume & Container	Holding Time
Groundwater	8	1 (FB)	0	PFOA, PFOS, PFNA	EPA 537	4ºC	2X125 HDPE plastic bottles	28 days
Groundwater	8	1 (FB)	0	SVOCs +TICs	8270C	4ºC	Amber glass 1L w/TFE lined cap	7 days to extract, 40 days after extraction
Groundwater	8	2 (FB, TB)	0	VOCs + TICs	8260B	4ºC, HCL	Clear Glass 40 mL	14 days
Groundwater	8	0	0	TOC	SM 5310 B-11	HCL, <6ºC	60 ml glass	28 days
Groundwater	8	1 (FB)	0	Chloride	EPA 300	<6ºC	500 mL plastic	28 days

Figure 1: Site Location Map



USGS MAP

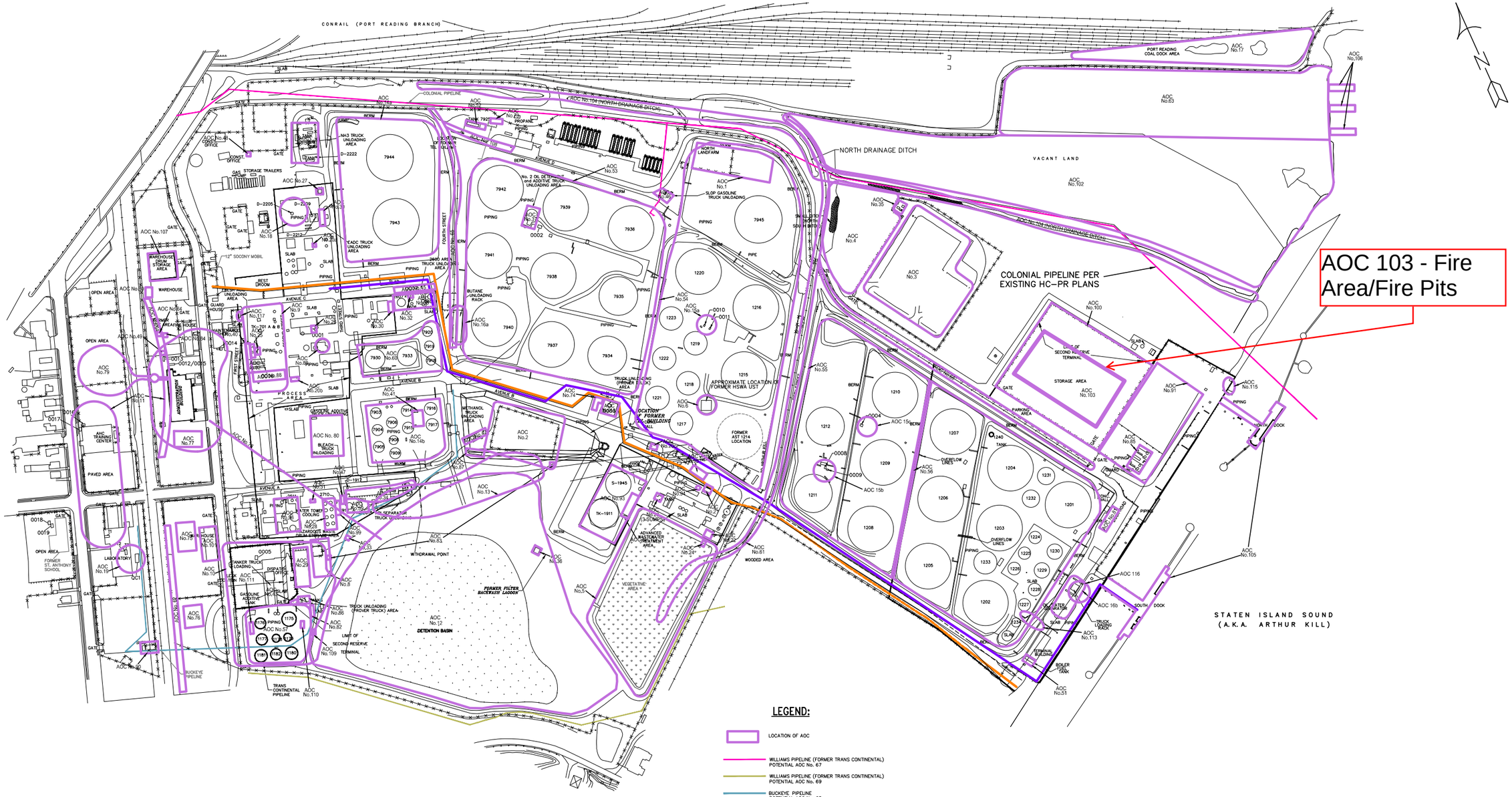
Hess Corporation Former Port Reading Complex (HC–PR)
750 Cliff Road
Port Reading, New Jersey

Earth Systems

Figure 1

09/15 FIG1

Figure 2: Location of Area of Concern



LEGEND:

- LOCATION OF AOC
- WILLIAMS PIPELINE (FORMER TRANS CONTINENTAL) POTENTIAL AOC No. 67
- WILLIAMS PIPELINE (FORMER TRANS CONTINENTAL) POTENTIAL AOC No. 69
- BUCKEYE PIPELINE POTENTIAL AOC No. 68
- 12" SPECTRA PIPELINE (FORMER TEXAS EASTERN) POTENTIAL AOC No. 71
- 10"ABANDONED SPECTRA PIPELINE (FORMER TEXAS EASTERN) POTENTIAL AOC No. 70
- ABANDONED COLONIAL PIPELINE POTENTIAL AOC No. 7 / ACO. NO. 72
- UNKNOWN PIPELINE POTENTIAL AOC No. 112
- RAILROAD
- SURFACE WATER (Approximate)

0 200 400

(SCALE IN FEET)

NOTES:

1. AOC – AREA OF CONCERN
2. SWMU – SOLID WASTE MANAGEMENT UNIT
3. UST – UNDERGROUND STORAGE TANK
4. AST – ABOVE GROUND STORAGE TANK
5. AOC BORDERS WILL MODIFY IN ACCORDANCE WITH FIELD INVESTIGATION RESULTS
6. AOCs 97 ABOVE GROUND PIPING RUNS ARE NOT DEPICTED ON THIS FIGURE
7. AOCs 98 STORM&PROCESS SEWERS ARE NOT DEPICTED ON THIS FIGURE
8. * A HISTORIC AVERAGE DEPTH TO WATER WAS USED FOR TR-4DD TO GENERATE CONTOURS; GAUGED VALUE FOR 5/22/15 IS INCONSISTENT WITH PRIOR EVENTS AND ASSUMED ERRONEOUS.

HISTORIC / POTENTIAL AREA OF CONCERN MAP

Hess Corporation Former Port Reading Complex (HC–PR)
750 Cliff Road
Port Reading, New Jersey

Earth Systems

Figure 2

09/15 FIG5

Appendix 1: Laboratory Quality Assurance / Quality Control Manual (Electronic Copy Only)

ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

Prepared by: Norm Farmer Date: 03/18/19

Approved by: Mike Eger Date: 03/18/19

Annual Review

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TITLE: ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

REFERENCES: LC/MS/MS and QSM 5.1 Table B-15

REVISED SECTIONS: 1.1.3, 1.2.1, 1.2.4, 5.5, 5.6, 6.4, 7.2.1, 7.2.2, 7.4.2.1, 7.4.2.2, 7.4.3, 7.4.4.3, 9.1, 9.2.1 and 12.0 Tables 1-4

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of select Per- and Polyfluorinated Alkyl Substances (PFAS) in water and solid matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).

1.1.2 Analytes that may be reported under this method are listed in TABLE 1.

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 2-20 ug/l for direct inject aqueous samples, 0.004-0.040 ug/l for SPE extracted aqueous samples and 1.0-4.0 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 **PFBA** and **PFOSA** tend to recover erratically by SPE cartridge. These analytes may also be lost during the evaporative step. Data for these analytes should be reviewed carefully. Alternate cartridges may be used depending on the specific analytes of interest.

1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I”

qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.2 Summary

1.2.1 This method is adapted from EPA 537 and modified for the analysis of environmental water and soil samples utilizing an isotope dilution standard technique.

This SOP is not compliant with QSM 5.1 or 5.2, Table B-15. For DoD samples needing QSM 5.1 compliance, see SOP MS019.

This SOP is not designed to be used to analyze drinking water by EPA 537. Drinking water samples should be analyzed by SOP MS017.

1.2.2 Samples are received, stored, and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS – Orlando SOP OP069 and OP070.

1.2.4 Samples known to be high in PFCs (such as AFFF) may be screened by serially diluting and analyzing by direct injection onto the LC/MS/MS. For definitive analysis these samples must be subcontracted to a laboratory certified for AFFF analysis by QSM 5.1 or 5.2.

1.2.5 Perfluorinated compounds are separated, detected, and quantitated using an LC/MS/MS. After HPLC separation and ionization, the specific Perfluorinated compound is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments are introduced into the second mass spectrometer where they are detected and quantified.

1.2.6 Perfluorinated analytes may exist in branched and/or linear form. Fluorotelomer production results in linear isomers only but electrochemical fluorination results in branched and linear isomers. The branched isomers may account for up to 30% of the total analyte. The branched isomer will elute just before the linear isomer.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in 125mL polyethylene bottles. A 125mL polyethylene wide mouth bottle is recommended for solid samples. Caps must not have Teflon liners.

2.1.2 Chlorinated finish waters or samples expected to have extreme pH's may be treated with 5.0 g/L of Trizma®.

2.1.3 The samples must be chilled to ≤10°C from the time of collection until arrival at the laboratory. Samples must not exceed 10°C during the first 48 hours after collection. The samples must be refrigerated at ≤ 6°C from the time of receipt until extraction.

2.1.4 The extracts must be stored at ≤6°C to minimize the potential for methanol evaporation but must be allowed to come to room temperature prior to analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 28 days of collection.

2.2.2 Solid and waste samples must be extracted within 28 days of collection.

2.2.3 Extracts must be analyzed within 40 days of extraction.

2.2.4 Direct injection samples should be analyzed within 28 days of collection.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All these materials must be demonstrated to be free from interferences.

3.2 Contact with glass containers, pipettes, or syringes should be minimized since the Perfluorinated compounds can potentially adsorb to glass surfaces.

3.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of the humic content of the sample.

3.4 SPE cartridges can be a source of interferences. The analysis of field and method blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

3.5 Water and containers used for equipment blanks or field blanks should be tested prior to use. For smaller sampling events DI water will be provided in the same type of bottle used for sample collection. For larger sampling events four-liter collapsible LDPE containers should be used. Containers should be filled with DI water and allowed to sit for several hours before testing. If the bottles are from the same lot and filled with DI on the same day, then one analysis per 10 containers should suffice. The DI water and

container blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.

3.6 A field blank should be collected with each set of samples. Each field blank consists of 4 bottles. Two bottles are filled with DI water at the lab and the other two bottles are empty. If Trizma® is being used for the samples then the two bottles with DI water should also contain Trizma®. At the sampling site the sampler should open then two empty bottles and transfer the DI water from the full bottles into them. Cap the bottles, label as field blanks, and return them to the laboratory along with the samples for analysis.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

4.5 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.

4.6 Isotope Dilution Standards (Extracted Internal Standards): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13 or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs. The terms isotope dilution standards and extracted internal standard are used interchangeably throughout this SOP. Technically if a direct mass labelled analog is used to quantitate the native analyte it is an isotope dilution technique; however, if a direct mass labelled analog is not available for quantitation and a similar mass labelled analog is used, it is an extracted internal standard technique.

4.7 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.

4.8 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.9 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.10 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.11 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.12 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.13 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Acetic Acid – HPLC grade or equivalent

5.4 Perfluorinated Alkyl Substances stock standards – Traceable to Certificate of Analysis.

5.5 Mass labeled – Injection Standards (Optional)

Perfluoro-[1,2-13C2]octanoic acid (13C2-PFOA)
Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid (13C4-PFOS)

5.6 Mass labeled – Isotope Dilution Standards – Extracted Internal Standards

13C4-PFBA	13C6-PFDA	13C8-PFOS
13C5-PFPeA	13C7-PFUnDA	13C8-FOSA
13C5-PFHxA	13C2-PFDoDA	13C2-4:2FTS
13C4-PFHpA	13C2-PFTeDA	13C2-6:2FTS
13C8-PFOA	13C3-PFBS	13C2-8:2FTS
13C9-PFNA	13C3-PFHxS	d3-MeFOSAA
13C3-HFPO-DA		d5-EtFOSAA*

If interferences (increasing area counts) are noted with d5-EtFOSAA during the initial calibration it should be omitted and the reference for EtFOSAA changed to d3-MeFOSAA.

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260

Suitable HPLC equipped with an autosampler, pump, and column compartment. System may have a membrane degasser.

6.2 MS/MS – Agilent Technologies 6460A or 6470

LC/MS/MS must be capable of negative ion electrospray ionization near the required flow rate of the HPLC Column. The system must be capable of performing MS/MS to produce unique precursor and product ions for the PFAS method analytes within the specified retention time segments. A minimum of 10 scans across each peak is required to ensure adequate precision.

6.3 Data System – Agilent Technologies MassHunter B.07.0x and B.08.0x.

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software should allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Columns: Agilent Poroshell 120 EC C18 2.7um, 100 x 2.1 mm ID or equivalent

6.5 Disposable polyethylene transfer pipettes

6.6 15ml Centrifuge tubes

6.7 Polyethylene screw cap and autosampler vials

6.8 Volumetric Pipettors and volumetric “plasticware” for dilutions of standards and extracts.

6.9 125ml and 250ml HDPE bottles – shown to be PFC free

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and isotope dilution standard concentrations, preparation information, and vendor part numbers can be found in the MS STD Summary in the Active SOP directory. A summary of the calibration concentrations can be found in Table 4.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes. Intermediate standards should be stored in polyethylene vials.

7.1.3 Calibration Standards

Calibration standards for Perfluorinated analytes are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in methanol. The low standard is at a concentration at or below the RL and the remaining standards defines the working range of the detector. Calibration standards should be stored in polyethylene vials. See Table 4 for levels.

Perfluorinated analytes may exist in branched and/or linear form. If a branched form is commercially available, then the calibration standards must contain the branched and linear form. PFHxS and PFOS are currently

available in mixes of branched and linear isomers. PFOA is available as a technical mix.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

3-5ul autosampler injection

Column temperature – 50.0 °C

Gradient Program

Time (min)	Water (0.1% acetic acid)	MeOH (0.1% acetic acid)	Flow ml/min
0-0.0	65%	35%	0.4
0-7.0	0%	100%	0.4
7.0-10.0	0%	100%	0.7
10.0-11.0	0%	100%	0.7
11.0-15.0	65%	35%	0.4

7.2.2 MS/MS Conditions

Parameter	Value	Parameter	Value
Gas Temp C	250	Sheath Gas Flow (l/min)	10
Gas Flow (l/min)	10	Capillary (V)	4500
Nebulizer (psi)	50	V Charging	600
Sheath Gas Heater	275	Ionization Mode	Neg ESI

Fragmentation voltages and collisions energies are optimized for each analyte and are stored in the instrument method. Precursor ions and transition masses are listed in Table 2.

LC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Low Level Aqueous Samples

A 125ml or 250ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with methanol, concentrated and the final volume is adjusted to 1.0ml, and then transferred to a vial for storage. Refer to SOP OP069.

7.3.2 Solid Samples

A 2-gram aliquot of sample is extracted with methanol or a basic methanol and water mix utilizing an ultrasonic bath, concentrated and the final volume is adjusted to 1.0ml, and then transferred to a vial for storage. Refer to SOP OP070.

7.3.3 High Level Aqueous and Non-Aqueous Samples

A 1.0ml aliquot of sample is serially diluted into DI water or methanol. Sample is screened to determine the final dilutions. Cautions must be taken because high level samples could potentially contaminate the lab or instrument.

7.4 HPLC/MS/MS Analysis

Instrument calibration consists of four major sections:

Mass Tuning and Calibration
Transition Window Selection
Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Mass Tuning & Calibration and Transition Window Selection

Before samples can be run, the LC/MS/MS system must be mass calibrated, and tune checked.

The instrument must be hardware tuned per manufacturer's instructions after any maintenance is performed and prior to analyzing a new calibration curve. The Agilent mass calibration ranges from 112.986 to 2833.873 amu.

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration must be updated as needed. (i.e. QC failures, ion masses showing large deviations from known masses, or major instrument maintenance is performed).

Verify the instrument tune and mass calibration by analyzing a mid-point Perfluorinated compound standard. This may be done using the daily CCV. The ions must be within ± 0.5 amu of the expected mass.

The mid-point standard is also used to check the analyte retention times. These retention times are used to update the transition windows. The windows must be wide enough to ensure that the branched and linear isomer for PFHxS and PFOS are completely within the transition window. The branched isomer will elute just prior to the linear isomer. If they are partially cut off, adjust the retention time of the linear isomer or the width of the transition window. Use a similar size window for the other analytes that do not have a branched standard. Later eluting peaks are broader and require a slightly wider transition window.

7.4.2 Initial Calibration Procedures

Before samples can be run, the LC/MS/MS system must be calibrated.

7.4.2.1 Isotope Dilution Standard (Extracted Internal Standard) Calibration

A minimum 5-point calibration curve is created for the native PFAS compounds using an Isotope Dilution or Extracted Internal Standard technique. SGS - Orlando routinely performs an 8-point calibration to maximize the calibration range and to allow for quadratic fits. See Table 4.

The calibration standards for PFHxS and PFOS must consist of both branched and linear isomers. The branched isomer elutes just prior to the linear isomer. PFCs are currently being reported as the sum of the branched and linear isomers so both peaks must be integrated.

Response factors (RF) for each analyte at each calibration level are determined as follows:

$$RF = (A_{analyte} \mathbf{X} C_{ids})/(A_{ids} \mathbf{X} C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{ids} = area of the isotope dilution standard
$C_{analyte}$ = concentration of the analyte
C_{ids} = concentration of the isotope dilution standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples.

Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions and forced origins. Linear regressions may be unweighted or weighted as $1/x$ or $1/x^2$. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq$0.990) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Linear Curve Fit $y = ax + b$

y = response ratio x = concentration ratio

a = linear term b = constant term

Quadratic Curve Fit $y = ax^2 + bx + c$

y = response ratio x = concentration ratio

a = quadratic term b = linear term c = constant term

Each point must be refitted against the initial calibration. Use % Error to evaluate the difference between the measured and the true amounts or concentrations used to create the model. The MassHunter software will do this automatically.

Calculation of the % Error

% ERR = (xi-x'i) / xi * 100

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte must be ≤ ±30% for all standards (70-130% of True Value), except the lowest point which must be ≤ ±50% for all standards (50-150% of True Value).

7.4.2.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

NOTE: Second source standards may consist of linear isomers only.

NOTE: Analyze the PFOA Technical Mix to identify the branched isomers. This is a qualitative standard only.

The %D for the compounds of interest must be ≤ ±30% (70-130% of True Value). If the ICV does not meet these criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source (if available). If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet

criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for all of the Perfluorinated analytes.

7.4.2.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification and quantitation of target compounds. They are also helpful in setting transition windows. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Generally internal calibration methods utilize relative retentions times. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.1 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Initial peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks extracted internal standards and injection standard are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

7.4.2.4 Ion Ratios

A minimum of two transition ions are monitored for each target analyte except for PFBA and PFPeA (which only have a single transition ion).

Transition ions are listed in Table 2 and structures for each transition are listed in Table 3.

The ratio of the primary and secondary transition masses should be updated from the initial calibration. They may be updated from the midpoint standard or from an average of all levels. Additionally, the ion ratio may be updated from the opening daily CCV.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within ± 30% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 10 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.3 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the Perfluorinated compounds are prepared at low and mid-range concentration. CCV standards are prepared from the same stock as the initial calibration standards.

A low level CCV must be analyzed prior to sample analysis and at least once every 24 hours to ensure accuracy at the LOQ.

The CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| must be $\leq$ ±30% for the analytes in the mid-point CCV and the |%D| must be $\leq$ ±50% for the analytes in the low level CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria then the system is considered in control and results may be reported.

If the |%D| is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Qualifying the data should only be done if the sample cannot be reanalyzed. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV and low level CCV)
CCV Standards
Low-Level (LOQ)
Mid-Level
QC Extracts
Sample Extracts
Bracketing CCV Standards

7.4.4.2 Two microliters of injection standard solution is added to every 100ul of extract in the autosampler vial. Generally, 500ul of extract are transferred to the autosampler vial with a gas tight syringe. Injection Standards are optional.

7.4.4.3 Three to five microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.4.4 Tentative identification of an analyte occurs when the peak from the sample extract falls within the retention time window of the target compound.

7.4.4.5 Positive identification is confirmed by comparing the ion ratio in the sample to the ion ratio of the standards. For the linear isomer, the primary and secondary transition masses must both be present. For the branched isomer the primary and secondary transition masses should both be present. In rare circumstances a particular branched peak may only exhibit a single transition ion.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within ± 30% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 10 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.4.6 Some of the PFASs may have multiple chromatographic peaks due to the presence of linear and branched isomers. This is prevalent in

PFHxS and PFOS. The areas of all the linear and branched isomers peaks must be included and the concentrations reported as a total for each of these analytes.

NOTE: The branched isomers must be included in the quantitation even if the calibration is based on just the linear isomer.

7.4.4.7 If the compound identification does not confirm, then the result should be reported as ND or "U".

7.4.4.8 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

Dilutions for this method are performed differently depending on the concentration of the target analytes in the extract. For dilutions in the 2-10 fold range, the extract is diluted with a methanol:water mix. No additional isotope dilution standards are added. For dilutions greater than 10-fold, additional isotope dilution standards are added. The theoretical concentration of the isotope dilution standards in the extract will need to be entered into MassHunter so that the software can correctly calculate the native analyte concentration.

7.4.4.9 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method

performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of isotope dilution standards and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). All control limits are updated annually and are listed in the LIMS.

9.1 Injection Standards (Optional)

Perfluoro-[1,2-13C2]octanoic acid (13C2-PFOA) and Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid (13C4-PFOS) are used as injection standards for this method.

The response of the Injection Standards in all subsequent runs must be ±50% of the response from the initial calibration midpoint standard. When Injection Standards are not used, the response of the Isotope Dilution Standards should be monitored closely.

9.1.1 If the injection standard responses are not within limits, the following are required.

9.1.1.1 Check to be sure that there are no errors in calculations, integrations, or injection standard solutions. If errors are found, recalculate the data accordingly.

9.1.1.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.1.1.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.1.4 If upon reanalysis, the responses are still not within limits, reanalyze the sample at a dilution.

9.1.1.5 If upon analysis of the dilution the responses are within limits, then the sample or select analytes may need to be reported from the dilution or qualified.

9.1.1.6 The responses of the isotope dilution standards can be used to help assess the data too.

9.2 Isotope Dilution Standards

9.2.1 The analytes listed in section 5.6 are used as the isotope dilution standards for this method.

A known amount of isotope dilution standard is added to each sample including the QC set prior to extraction. The aqueous recovery limits (corrected for dilution) for each isotope dilution standard are listed below:

Isotope Dilution Standard	Recovery Limit	Isotope Dilution Standard	Recovery Limit	Isotope Dilution Standard	Recovery Limit
13C4-PFBA	30-140	13C6-PFDA	50-150	13C8-FOSA	30-140
13C5-PFPeA	40-140	13C7-PFUnDA	50-150	d3-MeFOSAA	40-140
13C5-PFHxA	50-150	13C2-PFDoDA	40-150	d5-EtFOSAA	40-140
13C4-PFHpA	50-150	13C2-PFTeDA	40-150	13C2-4:2FTS	50-150
13C8-PFOA	50-150	13C3-PFBS	50-150	13C2-6:2FTS	50-150
13C9-PFNA	50-150	13C3-PFHxS	50-150	13C2-8:2FTS	50-150
		13C8-PFOS	50-150	13C3-HFPO-DA	50-150

Recovery Limits are updated periodically and the current limits for both water and soil samples are stored in LIMS. Isotope recoveries in complex matrices such as landfill leachates, sludges, or biosolids may not achieve limits generated for conventional waters or soils.

The % recovery may be calculated by direct comparison of the isotope dilutions standard responses to the response from the initial calibration midpoint standard or they may be calculated from the calculated concentrations.

% Recovery = (Sample Amount / Amount Spiked) X 100

Only those isotope dilution standards that directly link to the native analytes being reported need to pass. For example, 13C4-PFBA only needs to pass if PFBA is being reported.

9.2.2 If any isotope dilution standard response/recovery is not within the established control limits, the following are required.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, isotope dilution standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.2.2.3 Check for instrument suppression or enhancement by reanalyzing the sample at a dilution.

9.2.2.4 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.2.2.5 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Isotope dilution standards from both sets of analysis should be reported on the final report.

9.3 Method Blank

9.3.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable. Common laboratory contaminants must be below the LLOQ if present. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. At a minimum the samples must be re-extracted and reanalyzed for confirmation. If the re-extracted sample result confirms the original ND result, then the original result can be reported without qualification. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Blank Spike

9.4.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated. Alternate SPE cartridges may improve the recovery of select analytes such as PFBA and PFOSA.

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects the resulting data must be qualified accordingly.

9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and

accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the MS and MSD must be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each Perfluorinated compound in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst})$ X (V_F / V_I) X DF

Soil (ug/kg) = $[(CONC_{inst})$ X (V_F / W_I) X DF] / %solids

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF or curve fit
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst must follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Wastewater and methanol from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

EPA Method 537.1 Revision 1.0, November 2018

DOD QSM 5.0, July 2013

DOD QSM 5.1, January 2017

DOD QSM 5.2, February 2019

Standard Operating Procedure for the Extraction and Quantitation of Perfluorinated Compounds from Surface Soils, Methods Development and Application Branch, US EPA, Mark Strynar, October 2008

Standard Test Method for Determination of Perfluorinated Compounds by LC/MS/MS, ASTM D7968-17

EPA Technical Advisory: Laboratory Analysis of Drinking Water Samples for PFOA Using EPA Method 537 Rev. 1.1, EPA 815-B-16-021, September 2016

TABLE 1: Target Analytes

Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFOcDA	16517-11-6
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	474511-07-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
4:2 Fluorotelomer sulfonate	4:2FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2FTS	39108-34-4
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-Methyl perfluorooctanesulfonamidoacetic acid	MeFOSAA	2355-31-9
N-Ethyl perfluorooctanesulfonamidoacetic acid	EtFOSAA	2991-50-6
Hexafluoropropylene oxide dimer acid (GenX)	HFPO-DA	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11CL-PF3OUdS	763051-92-9

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	Precursor Ion	Prod Ion Primary	Prod Ion Secondary
13C4-PFBA	IDS	217	172	
PFBA	Native	213	169	
13C5-PFPeA	IDS	268	223	
PFPeA	Native	263	219	
13C5-PFHxA	IDS	318	273	
PFHxA	Native	313	269	119
13C4-PFHpA	IDS	367	322	
PFHpA	Native	363	319	169
13C2-PFOA	INJ	415	370	
13C8-PFOA	IDS	421	376	
PFOA	Native	413	369	169
ADONA	Native	377	251	85
13C9-PFNA	IDS	472	427	
PFNA	Native	463	419	219
13C6-PFDA	IDS	519	474	
PFDA	Native	513	469	219
9Cl-PF3ONS	Native	531	351	
13C7-PFUnDA	IDS	570	525	
PFUnDA	Native	563	519	269
13C2-PFDoDA	IDS	615	570	
PFDoDA	Native	613	569	319
PFTrDA	Native	663	619	369
11CL-PF3OUdS	Native	631	451	
13C2-PFTeDA	IDS	715	670	
PFTeDA	Native	713	669	219

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	Precursor Ion	Prod Ion Primary	Prod Ion Secondary
13C3-PFBS	IDS	302	99	
PFBS	Native	299	80	99
13C3-PFHxS	IDS	402	99	
PFPeS	Native	349	80	99
PFHxS	Native	399	80	99
PFHpS	Native	449	80	99
13C4-PFOS	INJ	503	80	
13C8-PFOS	IDS	507	99	
PFOS	Native	499	80	99
PFNS	Native	549	80	99
PFDS	Native	599	80	99
13C8-FOSA	IDS	506	78	
FOSA	Native	498	78	478
d3-MeFOSAA	IDS	573	419	
MeFOSAA	Native	570	419	512
d5-EtFOSAA	IDS	589	419	
EtFOSAA	Native	584	419	483
13C2-4:2FTS	IDS	329	309	
4:2FTS	Native	327	307	81
13C2-6:2FTS	IDS	429	409	
6:2FTS	Native	427	407	81
13C2-8:2FTS	IDS	529	509	
8:2FTS	Native	527	507	81
13C3-HFPO-DA	IDS	287	169	
HFPO-DA (GenX)	Native	329	285	169

TABLE 3: Precursor and Transition Ion Structure

Analyte	MW	Precursor Ion Mass	Prod Ion Primary	Prod Ion Secondary
	Parent Structure	Precrusor Ion Structure	Prim Ion Structure	Sec Ion Structure
PFBA	214	213	169	
	$CF_3(CF_2)_2COOH$	$CF_3(CF_2)_2COO$	$CF_3(CF_2)_2$	
PFPeA	264	263	219	
	$CF_3(CF_2)_3COOH$	$CF_3(CF_2)_3COO$	$CF_3(CF_2)_3$	
PFHxA	314	313	269	119
	$CF_3(CF_2)_4COOH$	$CF_3(CF_2)_4COO$	$CF_3(CF_2)_4$	CF_3CF_2
PFHpA	364	363	319	169
	$CF_3(CF_2)_5COOH$	$CF_3(CF_2)_5COO$	$CF_3(CF_2)_5$	$CF_3(CF_2)_2$
PFOA	414	413	369	169
	$CF_3(CF_2)_6COOH$	$CF_3(CF_2)_6COO$	$CF_3(CF_2)_6$	$CF_3(CF_2)_2$
PFNA	464	463	419	219
	$CF_3(CF_2)_7COOH$	$CF_3(CF_2)_7COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_3$
PFDA	514	513	469	219
	$CF_3(CF_2)_8COOH$	$CF_3(CF_2)_8COO$	$CF_3(CF_2)_8$	$CF_3(CF_2)_3$
PFUnDA	564	563	519	269
	$CF_3(CF_2)_9COOH$	$CF_3(CF_2)_9COO$	$CF_3(CF_2)_9$	$CF_3(CF_2)_4$
PFDoDA	614	613	569	319
	$CF_3(CF_2)_{10}COOH$	$CF_3(CF_2)_{10}COO$	$CF_3(CF_2)_{10}$	$CF_3(CF_2)_5$
PFTrDA	664	663	619	369
	$CF_3(CF_2)_{11}COOH$	$CF_3(CF_2)_{11}COO$	$CF_3(CF_2)_{11}$	$CF_3(CF_2)_6$
PFTeDA	714	713	669	219
	$CF_3(CF_2)_{12}COOH$	$CF_3(CF_2)_{12}COO$	$CF_3(CF_2)_{12}$	$CF_3(CF_2)_3$
PFBS	338	299	80	99
	$CF_3(CF_2)_3SO_3K$	$CF_3(CF_2)_3SO$	SO_3	FSO_3
PFPeS	372	349	80	99
	$CF_3(CF_2)_4SO_3Na$	$CF_3(CF_2)_4SO_3$	SO_3	FSO_3
PFHxS	422	399	80	99
	$CF_3(CF_2)_5SO_3Na$	$CF_3(CF_2)_5SO_3$	SO_3	FSO_3
PFHpS	472	449	80	99
	$CF_3(CF_2)_6SO_3Na$	$CF_3(CF_2)_6SO_3$	SO_3	FSO_3
PFOS	522	499	80	99
	$CF_3(CF_2)_7SO_3Na$	$CF_3(CF_2)_7SO_3$	SO_3	FSO_3
PFNS	572	549	80	99
	$CF_3(CF_2)_8SO_3Na$	$CF_3(CF_2)_8SO_3$	SO_3	FSO_3
PFDS	622	599	80	99
	$CF_3(CF_2)_9SO_3Na$	$CF_3(CF_2)_9SO_3$	SO_3	FSO_3
FOSA	499	498	78	478
	$CF_3(CF_2)_7SO_2NH_2$	$CF_3(CF_2)_7SO_2NH$	SO_2N	$(CF_2)_8SO_2N$
MeFOSAA	571	570	419	512
	$CF_3(CF_2)_7SO_2N(CH_3)CH_2COOH$	$CF_3(CF_2)_7SO_2N(CH_3)CH_2COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_7SO_2NCH_3$
EtFOSAA	585	584	419	483
	$CF_3(CF_2)_7SO_2N(C_2H_5)CH_2COOH$	$CF_3(CF_2)_7SO_2N(C_2H_5)CH_2COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_7SO_2$
4:2FTS	350	327	307	81
	$CF_3(CF_2)_3(CH_2)_2SO_3Na$	$CF_3(CF_2)_3(CH_2)_2SO_3$	$CF_3(CF_2)_3(C)_2SO_2$	HSO_3
6:2FTS	450	427	407	81
	$CF_3(CF_2)_5(CH_2)_2SO_3Na$	$CF_3(CF_2)_5(CH_2)_2SO_3$	$CF_3(CF_2)_5(C)_2SO_2$	HSO_3
8:2FTS	550	527	507	81
	$CF_3(CF_2)_7(CH_2)_2SO_3Na$	$CF_3(CF_2)_7(CH_2)_2SO_3$	$CF_3(CF_2)_7(C)_2SO_2$	HSO_3
GenX	330	329	285	169
	$CF_3(CF_2)_2OCFCF_3COOH$	$CF_3(CF_2)_2OCFCF_3COO$	$CF_3(CF2)_2OCFCF_3$	$CF_3(CF_2)_2$
ADONA	400	377	251	85
	$CF_3O(CF_2)_3OCHFCF_2COONa$	$CF_3O(CF_2)_3OCHFCF_2COO$	$CF_3O(CF_2)_3O$	CF_3O
9Cl-PF3ONS	554	531	351	533->353
(F53B major)	$ClF_2C(CF_2)_5O(CF_2)_2SO_3Na$	$ClF_2C(CF_2)_5O(CF_2)_2SO_3$	$ClF_2C(CF_2)_5O$	$^{35}Cl/^{37}Cl$ ratio
11Cl-PF3OUdS	654	631	451	633->453
(F53B minor)	$ClF_2C(CF_2)_7O(CF_2)_2SO_3Na$	$ClF_2C(CF_2)_7O(CF_2)_2SO_3$	$ClF_2C(CF_2)_7O$	$^{35}Cl/^{37}Cl$ ratio

TABLE 4: Standard Levels

	LC/MS/MS for PFAAs LEVELS IN PPB												
COMPOUND	ICAL									ICV1	ICV2	SPIKE	ID STD
Perfluorobutanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluoropentanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorohexanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluoroheptanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorooctanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0	20.0	20.0	
Perfluorononanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorodecanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluoroundecanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorododecanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorotridecanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorotetradecanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorobutanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluoropentanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorohexanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluoroheptanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorooctanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorononanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorodecanesulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Perfluorooctane sulfonamide	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
N-MeFOSAA	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0	20.0	20.0	
N-EtFOSAA	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0	20.0	20.0	
4:2 Fluorotelomer sulfonate	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
6:2 Fluorotelomer sulfonate	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
8:2 Fluorotelomer sulfonate	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
Hexafluoropropylene oxide dimer acid (GenX)	2.5	5.0	10.0	25.0	50.0	100.0	250.0	400.0	500.0	100.0		100.0	
4,8-dioxa-3H-perfluorononanoic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	0.5	1.0	2.0	5.0	10.0	20.0	50.0	80.0	100.0	20.0		20.0	
MPFAC-24ES Isotope Dilutions STD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		20.0
13C3-HFPO-DA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0
Perfluoro-[1,2-13C2]octanoic acid INJ STD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		
Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid INJ STD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		
	Note: 0.5 ppb level must be included for any analyte being reported to 2 ng/l												
	Note: 80ppb may be added to curve in place of the 10ppb.												

$$Mass_{acid} = Mass_{salt} \mathbf{X} MW_{acid}/MW_{salt}$$

MW_{acid} = Molecular weight of PFAA
MW_{salt} = Molecular weight of the salt

Annual Certified Parameter List

SGS NORTH AMERICA INC. - ORLANDO (Lab ID Number: FL002)

4405 VINELAND RD
ORLANDO FL 32811

Lab Contact Name	SVETLANA IZOSIMOVA
E-mail Address	svetlana.izosimova@sgs.com
Contact Phone Number	407-425-6700
Fax Number	407-425-0707

Parameter	Matrix Code	Status	Approved Method	Technique	Parameter Code	Latest Certification Status Date	Eligible to Report NJ Data	Nelap State or Country Code
Perfluorooctanesulfonic acid (PFOS)	DW	Certified	EPA 537	LC MS/MS, Electrospray Ionization	DW09.05120	11/12/2015	Yes	FL
Perfluorooctanoic acid (PFOA)	DW	Certified	EPA 537	LC MS/MS, Electrospray Ionization	DW09.05130	11/12/2015	Yes	FL
Perfluorooctanesulfonic acid (PFOS)	NPW	Certified	User Defined ALS MS 014	LC MS/MS, Electrospray Ionization	NPW16.02430	4/25/2018	Yes	FL
Perfluorooctanoic acid (PFOA)	NPW	Certified	User Defined ALS MS 014	LC MS/MS, Electrospray Ionization	NPW16.02440	4/25/2018	Yes	FL

Quality Systems Manual

Volume XVII, Revision II: January 2016

Effective Date: January 2016

Document Control Number: 16

Nancy Cole, Laboratory Director
Technical Director-Inorganics

Nicholas C Straccione,
Quality Assurance Manager

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Introduction

The SGS Accutest Inc. Quality Assurance System, detailed in this plan, has been designed to meet the quality program requirements of the National Environmental Laboratory Accreditation Program (NELAP), ISO Guide 17025, the Department of Defense Environmental Laboratory Approval Program (DOD ELAP) and other National environmental monitoring programs. The plan establishes the framework for documenting the requirements of the quality processes regularly practiced by the Laboratory. The Quality Assurance Director is responsible for changes to the Quality Assurance Program, which is appended to the Quality System Manual (QSM) during the annual program review. The plan is also reviewed annually for compliance purposes by the Company President and Laboratory Director and edited if necessary. Changes that are incorporated into the plan are itemized in a summary of changes following the introduction. Plan changes are communicated to the general staff in a meeting conducted by the Director of Quality Assurance following the plan's approval.

The SGS Accutest Inc. plan is supported by standard operating procedures (SOPs), which provide specific operational instructions on the execution of each quality element and assure that compliance with the requirements of the plan are achieved. SGS Accutest Inc. employees are responsible for knowing the requirements of the SOPs and applying them in the daily execution of their duties. These documents are updated as changes occur and the staff is trained to apply the changes.

At SGS Accutest Inc., we believe that satisfying client requirements and providing a product that meets or exceeds the standards of the industry is the key to a good business relationship. However, client satisfaction cannot be guaranteed unless there is a system that assures the product consistently meets its design requirements and is adequately documented to assure that all procedural steps are executed, properly documented and traceable.

This plan has been designed to assure that this goal is consistently achieved and the SGS Accutest Inc. product withstands the rigors of scrutiny that are routinely applied to analytical data and the processes that support its generation.

Summary of Changes
SGS Accutest Inc. Quality System Manual – January 2016

Section	Page	Description
2.3	7	Chain of Command - Heather Hall _QA Director
3.0	9	QA organizational chart, Heather Hall _QA Director
8.12	34	Added performance limits from section 12.7
12.7	53	Removed, transferred to section 8.12
Appendix I		
Appendix III Methods		

Table of Contents

1.0 QUALITY POLICY

1.1 ***SGS Accutest Inc. Mission***:

SGS Accutest Inc. provides analytical services to commercial and government clients in support of environmental monitoring and remedial activities as requested. The Laboratory's mission is dedicated to providing reliable data that satisfies client's requirements as explained in the following:

"Provide easy access, high quality, analytical support to commercial and government clients which meets or exceeds data quality objectives and provides them with the data needed to satisfy regulatory requirements and/or make confident decisions on the effectiveness of remedial activities."

These services are provided impartially and are not influenced by undue commercial or financial pressures which might impact the staff's technical judgment. Coincidently, SGS Accutest Inc. does not engage in activities that endanger the trust in our independent judgment and integrity in relation to the testing activities performed.

1.2 ***Policy Statement***:

The management and staff of SGS Accutest Inc. share the responsibility for product quality and the commitment to the continual improvement of the quality system. Accordingly, SGS Accutest Inc.'s quality assurance program is designed to assure that all processes and procedures, which are components of environmental data production, meet established industry requirements, are adequately documented from a procedural and data traceability perspective, and are consistently executed by the staff. It also assures that analytical data of known quality, meeting the quality objectives of the analytical method in use and the data user's requirements, is consistently produced in the laboratory. This assurance enables the data user to make rational, confident, cost-effective decisions on the assessment and resolution of environmental issues.

The laboratory Quality System also provides the management staff with data quality and operational feedback information. This enables them to determine if the laboratory is achieving the established quality and operational standards, which are dictated by the client or established by regulation. The information provided to management, through the QA program, is used to assess operational performance from a quality perspective and to perform corrective action as necessary.

All employees of SGS Accutest Inc. participating in environmental testing receive quality system training and are responsible for knowing and complying with the system requirements. The entire staff shares SGS Accutest Inc.'s commitment to good professional practice.

01/19/2016

President & Chief Executive Officer — Date

2.0 ORGANIZATION

2.1 ***Organizational Entity***. SGS Accutest Inc. is a privately held, independent testing laboratory founded in 1956 and registered as a New Jersey Corporation. The headquarters are located in Dayton, New Jersey where it has conducted business since 1987. Satellite laboratories are maintained in Marlborough, Massachusetts; Orlando, Florida, Houston, Texas, San Jose, California, Wheat Ridge, Colorado, and Scott Louisiana.

2.2 ***Management Responsibilities***

Requirement: Each laboratory facility has an established chain of command. The duties and responsibilities of the management staff are linked to the Board of Directors/CEO of SGS Accutest Inc. who establishes the agenda for all company activities.

President/CEO. Primary responsibility for all operations and business activities. Delegates authority to laboratory directors, general managers, and the quality assurance director to conduct day to day operations and execute quality assurance duties. Each of the seven operational entities (New Jersey, Florida, Massachusetts, Texas, California, Colorado, and Louisiana) report to the President/CEO.

Laboratory Director. Executes day to day responsibility for laboratory operations including technical aspects of production activities and associated logistical procedures. Reports directly to the President/CEO.

Quality Assurance Director. Design, oversight, and facilitation responsibility for all Quality System elements identified in the Quality Program. Reports directly to the President/CEO.

Technical Directors (Organics/Inorganic). Responsible for day to day operations and activities of the organics and inorganics laboratories including scheduling, production and data quality. Reports directly to the Laboratory Director.

Organics Manager. Responsible for laboratory managers, supervisors and analyst performing daily laboratory procedures in semi-volatiles and organic prep.

Department Managers. Executes day to day responsibility for specific laboratory areas including technical aspects of production activities and associated logistical procedures. Directly report to the laboratory director.

Section Supervisors. Executes day to day responsibility for specific laboratory units including technical aspects of production activities and associated logistical procedures. Direct report to the Department Manager.

2.3 ***Chain of Command***

The responsibility for managing all aspects of the Company's operation is delegated to specific individuals, who have been assigned the authority to act in the absence of the senior staff. These individuals are identified in the following Chain of Command:

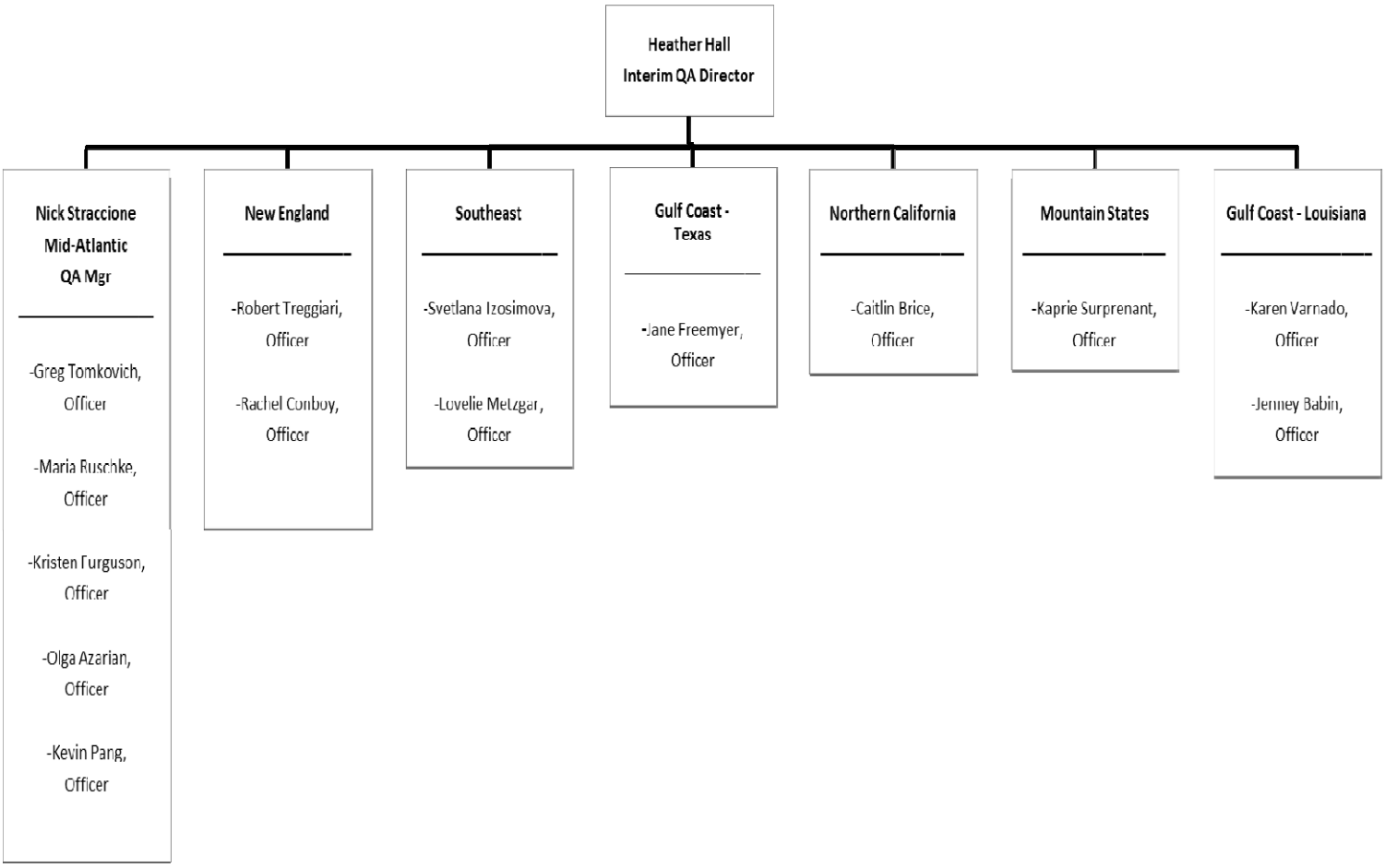
Karl Schoene, President & Chief Executive Officer SGS Accutest Inc.
Chad Tate, Chief Financial Officer
Nancy Cole, Laboratory Director
Heather Hall, Director, Corporate Quality Assurance
Matt Cordova, Director, Client Services

2.4 ***Organization Chart***

The hierarchy of the Company's operational control and oversight is illustrated in the SGS Accutest Inc. Organization Chart. Employees listed with an asterisk would be considered to be the appointed deputy in the event that the technical director or corporate quality assurance director are absent from their respective position for a period of time exceeding fifteen (15) consecutive calendar days. If this absence exceeds thirty-five (35) consecutive calendar days the laboratory shall notify the NJDEP-Office of Quality Assurance in writing.

Should this absence exceed sixty-five consecutive calendar days the DOD ELAP Accrediting Body shall be notified in writing.

Nancy Cole
Lab Director
Matt Cordova
Dir of Client Services/
Log-in Mgr
-Marty Vilanza,
PM
-Marie Meldof,
PM
-Mayur Patel,
PM
-Viktoriya Pashkova,
PM
Kelly Patterson,
PM Assistant
-Danny Axelrod,
PM
-Matthew Stoecklin,
PM Assistant
-Sue Witting,
Recep
-Tammy McCloskey,
Log-In Training/ Scheduling
Supervisor
-Michelle Jenkins
Log-In Technical Supervisor
Tim Hudson
Sample Mgmt
- Dave Hunkele,
Receiving Supervisor
-Rich Kasperowics,
Shipping Supervisor
-Andrew Siu,
2nd Shift Team Lead
-Keith Gardner,
Dispatch
Shirley Grzybowski
Custodial Supervisor
Jamie Yates
Gen Chem Mgr
-Mirela Casino,
Senior Data Review
-Shirley Gryzbowski,
Assistant Supervisor
-Rie Iwasaki,
Data Review
-Sean Wesolyk,
TCLP Team Lead
Wendy Zhou
Metals Mgr
-Mirela Casino,
Senior Data Review
-Nancy Duan,
Day Team Lead
-Gulcag Temizo,
Weekend
Team Lead
-Rakesh Pathak,
Night Team Lead
Owen McKenna
Semi-VOA Mgr
-Kristi Scholenberger,
GC/MS Supervisor
-Rebecca Krug,
Team Lead
-Joseph Ravino,
Team Lead
-Ashley Dye,
Team Lead
-Nina Pandya,
Team Lead
Owen McKenna
Interim Organics Mgr
-Rufeng Yao,
Tech Asst Mgr
-George Zhang,
Tech Asst Mgr
-Melinda Yan,
Scheduling
-Tom Rusowicz,
Tech Supervisor
-Robert Scot,
VOA Supervisor
-Dana Tryon,
VOA/Air Supervior
-JessicaHeltan,
VOA Asst Mgr
-Henry Salim,
Team Lead
-Juntae Park,
Supervisor
-Wei Dong,
Team Lead
-Kevin Hu,
Team Lead
Bruce Shulz
Extractions Mgr
-Lisa Brassell,
Day Supervisor
-Max Ponce,
Night Supervisor
-Deana Homig,
Supervisor
-Nicholas Goydish,
Team Lead
-Albert Cuarson,
Team Lead
Harold Meissner
Field Services
Mgr
Rebecca Grillo
Lab Liaison
Su Chou
Report Gen
Supervisor


Heather Hall
Interim QA Director
Nick Straccione
Mid-Atlantic
QA Mgr
-Greg Tomkovich, Officer
-Maria Ruschke, Officer
-Kristen Furguson, Officer
-Olga Azarian, Officer
-Kevin Pang, Officer
New England
-Robert Treggiari, Officer
-Rachel Conboy, Officer
Southeast
-Svetlana Izosimova, Officer
-Lovelie Metzgar, Officer
Gulf Coast - Texas
-Jane Freemyer, Officer
Northern California
-Caitlin Brice, Officer
Mountain States
-Kaprie Surprenant, Officer
Gulf Coast - Louisiana
-Karen Varnado, Officer
-Jenney Babin, Officer

3.0 QUALITY RESPONSIBILITIES OF THE MANAGEMENT TEAM

3.1 ***Requirement***: Each member of the management team has a defined responsibility for the Quality System. System implementation and operation is designated as an operational management responsibility. System design and implementation is designated as a Quality Assurance Responsibility.

President/CEO. Primarily responsible for process improvements to all business aspects of the company.

Laboratory Director. Responsible for implementing and operating the Quality System in all laboratory areas. Responsible for the design and implementation of corrective action for defective processes. Has the authority to delegate Quality System implementation responsibilities.

Quality Assurance Director. Responsible for design, implementation support, training, and monitoring of the quality system. Identifies product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if quality issues warrant immediate action. Monitors implemented corrective actions for compliance.

Technical Directors. Responsible for overseeing the technical aspects of the quality assurance system as they are integrated into method applications and employed to assess analytical control on a daily basis. The Technical directors review and acknowledge the technical feasibility of proposed QA systems involving technical applications of applied methodology.

Department Managers. Responsible for applying the requirements of the Quality System in their section and assuring subordinate supervisors and staff apply all system requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Section Supervisors & Team Leaders. Responsible for applying the requirements of the Quality System to their operation and assuring the staff applies all system requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Quality Assurance Officers. Responsible for design support, implementation support, training, and monitoring support for the quality system. Conducts audits and product reviews to identify product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Provides support for implemented corrective actions for compliance. Serves as the primary alternate in the absence of the Quality Assurance Director.

Bench Analysts. Responsible for applying the requirements of the Quality System to the analyses they perform, evaluating QC data and initiating corrective action for quality control deficiencies within their control. Implements global corrective action as directed by superiors.

3.2 ***Program Authority***. Authority for program implementation originates with the Board of Directors who bears the ultimate responsibility for system design, implementation, and enforcement of requirements. This authority and responsibility is delegated to the Director of Quality Assurance who performs quality functions independently without the encumbrances or biases associated with operational or production responsibilities to ensure an honest, independent assessment of quality issues.

3.3 ***Data Integrity Policy***. The SGS Accutest Inc. Data Integrity Policy reflects a comprehensive, systematic approach for assuring that data produced by the laboratory accurately reflects the outcome of the tests performed on field samples and has been produced in a bias free environment by ethical professionals. The policy includes a commitment to technical ethics, staff training in ethics and data integrity, an individual attestation to data integrity and procedures for evaluating data integrity. Senior management assumes the responsibility for assuring compliance with all technical ethics elements and operation of all data integrity procedures. The staff is responsible for compliance with the ethical code of conduct and for practicing data integrity procedures.

The SGS Accutest Inc. Data Integrity Policy is as follows:

"SGS Accutest Inc. is committed to producing data that meets the data integrity requirements of the environmental regulatory community. This commitment is demonstrated through the application of a comprehensive data integrity program that includes ethics and data integrity training, data integrity evaluation procedures, staff participation and management oversight. Adherence to the specifications of the program assures that data provided to our clients is of the highest possible integrity and can be used for decision making processes with high confidence."

Data Integrity Responsibilities

Management. Senior management retains oversight responsibility for the data integrity program and retains ultimate responsibility for execution of the data integrity program elements. Senior management is responsible for providing the resources required to conduct ethics training and operate data integrity evaluation procedures. They also include responsibility for creating an environment of trust among the staff and being the lead advocate for promoting the data integrity policy and the importance of technical ethics. The Quality Assurance Director is the designated ethics officer for the Company.

Staff. The staff is responsible for adhering to the company ethics policy as they perform their duties and responsibilities associated with sample analysis and reporting. By executing this responsibility, data produced by SGS Accutest Inc. retains its high integrity characteristics and withstands the rigors of all data integrity checks.

The staff is also responsible for adhering to all laboratory requirements pertaining to manual data edits, data transcription and data traceability. These include the application of approved

manual peak integration and documentation procedures. It also includes establishing traceability for all manual results calculations and data edits.

Ethics Statement. The SGS Accutest Inc. ethics statement reflects the standards that are expected for businesses that provide environmental services to regulated entities and regulatory agencies on a commercial basis. The Ethics Policy is comprised of key elements that are essential to organizations that perform chemical analysis for a fee. As such, it focuses on elements related to personal, technical and business activities.

SGS Accutest Inc. provides analytical chemistry services on environmental matters to the regulated community. The data the company produces provides the foundation for determining the risk presented by a chemical pollutant to human health and the environment. The environmental industry is dependent upon the accurate portrayal of environmental chemistry data. This process is reliant upon a high level of scientific and personal ethics.

It is essential to the Company that each employee understands the ethical and quality standards required to work in this industry. Accordingly, SGS Accutest Inc. has adopted a code of ethics, which each employee is expected to adhere to as follows:

- Perform chemical and microbiological analysis using accepted scientific practices and principles.
- Perform tasks in an honest, principled and incorruptible manner inspiring peers & subordinates.
- Maintain professional integrity as an individual.
- Provide services in a confidential, honest, and forthright manner.
- Produce results that are accurate and defensible.
- Report data without any considerations of self-interest.
- Comply with all pertinent laws and regulations associated with assigned tasks and responsibilities.

Data Integrity Procedures. Four key elements comprise the SGS Accutest Inc. data integrity system. Procedures have been implemented for conducting data integrity training and for documenting that employees conform to the SGS Accutest Inc. Data Integrity and Ethics policy.

The data integrity program consists of routine data integrity evaluation and documentation procedures to periodically monitor and document data integrity. These procedures are documented as SOPs. SOPs are approved and reviewed annually following the procedures

employed for all SGS Accutest Inc. SOPs. Documentation associated with data integrity evaluations is maintained on file and is available for review.

Data Integrity Training. SGS Accutest Inc. employees receive technical ethics training during new employee orientation. Employees are also required to refresh their ethical conduct agreement annually, which verifies their understanding of SGS Accutest Inc. ethics policy and their ethical responsibilities. A brochure summarizing the details of the SGS Accutest Inc. Data Integrity Policy is distributed to all employees with the Ethical Conduct Agreement. The refreshed agreement is appended to each individual's training file.

The training focuses on the reasons for technical ethics training, explains the impact of data fraud on human health and the environment, and illustrates the consequences of criminal fraud on businesses and individual careers. SGS Accutest Inc. ethics policy and code of ethics are reviewed and explained for each new employee.

Training on data integrity procedures are conducted by individual departments for groups involved in data operations. These include procedures for manual chromatographic peak integration, traceability for manual calculations and data transcription.

Data Integrity Training Documentation. Records of all data integrity training are maintained in individual training folders. Attendance at all training sessions is documented and maintained in the training archive.

SGS Accutest Inc. Data Integrity and Ethical Conduct Agreement. All employees are required to sign a Data Integrity and Ethical Conduct Agreement annually. This document is archived in individual training files, which are retained for duration of employment.

The Data Integrity and Ethical Conduct Agreement are as follows**:**

I. *I understand the high ethical standards required of me with regard to the duties I perform and the data I report in connection with my employment at SGS Accutest Inc.*

II. *I have received formal instruction on the code of ethics that has been adapted by SGS Accutest Inc. during my orientation and agree to comply with these requirements.*

III. *I have received formal instruction on the elements of SGS Accutest Inc. Data Integrity Policy and have been informed of the following specific procedures:*

   a. *Formal procedures for the confidential reporting of data integrity issues are available, which can be used by any employee,*

   b. *A data integrity investigation is conducted when data issues are identified that may negatively impact data integrity.*

c. *Routine data integrity monitoring is conducted on sample data, which may include an evaluation of the data I produce,*

IV. *I have read the brochure detailing SGS Accutest Inc. Data Integrity and Ethics Program as required.*

V. *I am aware that data fraud is a punishable crime that may include fines and/or imprisonment upon conviction.*

VI. *I also agree to the following:*

a. *I shall not intentionally report data values, which are not the actual values observed or measured.*

b. *I shall not intentionally modify data values unless the modification can be technically justified through a measurable analytical process.*

c. *I shall not intentionally report dates and times of data analysis that are not the true and actual times the data analysis was conducted.*

d. *I shall not condone any accidental or intentional reporting of inauthentic data by other employees and immediately report it's occurrence to my superiors.*

e. *I shall immediately report any accidental reporting of inauthentic data by myself to my superiors.*

Data Integrity Monitoring. Documented procedures are employed for performing data integrity monitoring. These include regular data review procedures by supervisory and management staff (Section 12.7), supervisory review and approval of manual integrations and periodic reviews of GALP audit trails from the LIMS and all computer controlled analysis.

Data Review. All data produced by the laboratory undergoes at least two levels of review the final review must be performed by a manager, supervisor or designated reviewer. Detected data anomalies that appear to be related to data integrity issues are isolated for further investigation. The investigation is conducted following the procedures described in this section.

Manual Peak Integration Review and Approval. Routine data review procedures for all chromatographic processes includes a review of all manual chromatographic peak integrations. This review is performed by the management staff and consists of a review of the machine integration compared to the manual integration. Manual integrations, which have been performed in accordance with SGS Accutest Inc. manual peak integration procedures, are approved for further processing and release. Identification of samples and analytes in which manual integration had been necessary may be recorded in a report case narrative specific to a particular client and project requirement.

Manual integrations which are not performed to SGS Accutest Inc. specifications are set aside for corrective action, which may include analyst retraining or further investigation as necessary.

Data Integrity Review. Data integrity audits are comprehensive data package audits that include a review of raw data, process logbooks, processed data reports and GALP audit trails from individual instruments and LIMS. GALP audit trails, which record all electronic data activities, are available for the majority of computerized methodology and the laboratory information management system (LIMS). These audit trails are periodically reviewed to determine if interventions performed by technical staff constitute an appropriate action. The review is performed on a recently completed job and may include interviews with the staff who performed the analysis. Findings indicative of inappropriate interventions or data integrity issues are investigated to determine the cause and the extent of the anomaly.

Confidential Reporting of Data Integrity Issues. Data integrity concerns may be raised by any individual to their supervisor. Employees with data integrity concerns should always discuss those concerns with their immediate supervisors as a first step unless the employee is concerned with the confidentiality of disclosing data integrity issues or is uncomfortable discussing the issue with their immediate supervisors. The supervisor makes an initial assessment of the situation to determine if the concern is related to a data integrity violation. Those issues that appear to be violations are documented by the supervisor and referred to the Director of Quality Assurance for investigation.

Documented procedures for the confidential reporting of data integrity issues in the laboratory are part of the data integrity policy. These procedures assure that laboratory staff can privately discuss ethical issues or report items of ethical concern without fears of repercussions with senior staff.

Employees with data integrity concerns that they consider to be confidential are directed to the Corporate Human Resources Manager in Dayton, New Jersey. The HR Manager acts as a conduit to arrange a private discussion between the employee and the Corporate QA Director or a local QA Officer.

During the employee - QA discussion, the QA representative evaluates the situation presented by the employee to determine if the issue is a data integrity concern or a legitimate practice. If the practice is legitimate, the QA representative clarifies the process for the employee to assure understanding. If the situation appears to be a data integrity concern, the QA representative initiates a Data Integrity Investigation following the procedures specified in SOP EQA059.

Data Integrity Investigations. Follow-up investigations are conducted for all reported instances of ethical concern related to data integrity. Investigations are performed in a confidential manner by senior management according to a documented procedure. The outcome of the investigation is documented and reported to the company president who has the ultimate responsibility for determining the final course of action in the matter. Investigation documentation includes corrective action records, client notification information and disciplinary action outcomes, which is archived for a period of five years.

The investigations are conducted by the senior staff and supervisory personnel from the affected area. The investigations team includes the Laboratory Director and the Quality Assurance Director. Investigations are conducted in a confidential manner until it is completed and resolved.

The investigation includes a review of the primary information in question by the investigations team. The team performs a review of associated data and similar historical data to determine if patterns exist. Interviews are conducted with key staff to determine the reasons for the observed practices.

Following data compilation, the investigations team reviews all information to formulate a consensus conclusion. The investigation results are documented along with the recommended course of action.

Corrective Action, Client Notification & Discipline. Investigations that reveal systematic data integrity issues will be referred for corrective action, resolution and disposition (Section 13). If the investigation indicates that an impact to data has occurred and the defective data has been released to clients, client notification procedures will be initiated following the steps in Section 18.7.

In all cases of data integrity violations, some level of disciplinary action will be conducted on the responsible individual. The level of discipline will be consistent with the violation and may range from retraining and/or verbal reprimand to termination. A zero tolerance policy is in effect for unethical actions.

4.0 JOB DESCRIPTIONS OF KEY STAFF

4.1 ***Requirement***: Descriptions of key positions within the organization are defined to ensure that clients and staff understand duties and the responsibilities of the management staff and the reporting relationships between positions.

President/CEO. Responsible for overall process improvement for all business processes. Is also responsible for Quality Assurance, IT Development and Health and Safety. Reports directly to the Board of Directors.

Laboratory Director. Reports to the company President/CEO. Establishes laboratory operations strategy. Direct supervision of client services, organic chemistry, inorganic chemistry, field services, and sample management. Maintains operational responsibility for the designated regional laboratories as defined in the SGS Accutest Inc. Organization Chart. Assumes the responsibilities of the CEO in his absence.

Vice President, Chief Information Officer. Reports to President/CEO. Develops IT Software and hardware agenda. Provides system strategies to compliment company objectives. Maintains all software and hardware used for data handling.

Vice President, Chief Financial Officer. Reports to the company President /CEO. Responsibilities include overseeing the Financial Accounting and Human Resource Department, Corporate Purchasing, Corporate IT Help Desk, and Salary and Benefit Administration.

Director, Quality Assurance. Reports to the company President/CEO and functions independently from laboratory operations. Establishes the company quality agenda, develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities, monitors the quality system, and provides quality system feedback to management to be used for process improvement. Assumes the responsibilities of the Laboratory Director in the absence of the Laboratory Director and the President/CEO.

Director Client Services. Reports to the Laboratory Director. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Manager, Organics (Organics Technical Director). Reports to the laboratory director. Directs the operations of the organics group, consisting of organics preparation and instrumental analysis. Establishes daily work schedule. Supervises method implementation, application, and data production. Responsible for following Quality System requirements. Maintains laboratory instrumentation in an operable condition. Assumes the responsibilities of the Laboratory Director in his absence.

Manager, Inorganics (Inorganics Technical Director). Reports to the laboratory director. Directs the operations of the inorganics group, consisting of wet chemistry and the metals laboratories. Establishes daily work schedule. Supervises method implementation, application, and data production. Responsible for following Quality System requirements. Maintains laboratory instrumentation in an operable condition. Assumes the responsibilities of the Laboratory Director in his absence.

Manager, Field Services. Reports to the laboratory director. Conducts field sampling and analysis of "analyze immediately" parameters in support of ongoing field projects. Responsible for proper collection, preservation, documentation and shipment of field samples. Maintains field sampling and field instrumentation required to perform primary responsibilities.

Manager, Sample Management. Reports to the laboratory director. Develops, maintains and executes all procedures required for receipt of samples, verification of preservation, and chain of custody documentation. Responsible for maintaining and documenting secure storage, delivery of samples to laboratory units on request and courier services.

Director, Environmental Health and Safety. Reports to the President/CEO. Responsible for developing company safety program and chemical hygiene plan. Reviews and updates these plans annually. Responsible for employee training on relevant health and safety topics. Documents employee training. Manages laboratory waste management program.

Manager, Wet Chemistry. Reports to the Lab Director. Executes daily analysis schedule. Supervises the analysis of samples for wet chemistry parameters using valid, documented methodology. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Assumes the responsibilities of the Inorganics Manager in his absence.

Manager, Metals. Reports to the Lab Director. Executes daily analysis schedule. Supervises the analysis of samples for metallic elements using valid, documented methodology. Documents all procedures and data production activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements.

Manager, Organic Preparation. Reports to the Lab Director. Executes the daily sample preparation schedule. Performs the extract of multi-media samples for organic constituents using valid, documented methodology. Prepares documentation for extracted samples. Assumes custody until transfer for analysis.

Technical Support Supervisor, Organics. Reports to the organic manager. Oversees all instrument maintenance and new equipment installation. Conducts method development and implementation tasks.

Manager, Semi VOA. Reports to the Lab Director. Expedites the analysis of samples and sample extracts. Executes daily analysis schedule. Supervises the analysis of samples for organic parameters using valid, documented methodology. Documents all data and data production activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Assumes the responsibilities of the Organics Manager in his absence.

Supervisor, Report Generation. Reports to the organics manager. Compiles raw and processed sample data and assembles into client-ready reports. Initiates report scanning for archiving purposes. Maintains raw batch data in accessible storage. Mails completed reports to clients according to specified report turnaround schedule.

Quality Assurance Officers. Reports to the Director, Quality Assurance. Performs quality control data review for trend monitoring purposes. Conducts internal audits and prepares reports for management review. Oversees proficiency testing program. Process quality control data for statistical purposes. Assumes the responsibilities of the Quality Assurance Director in his absence.

4.2 ***Employee Screening, Orientation, and Training***.

All potential laboratory employees are screened and interviewed by human resources and technical staff prior to their hire. The pre-screen process includes a review of their qualifications including education, training and work experience to verify that they have adequate skills to perform the tasks of the job.

Newly hired employees receive orientation training beginning the first day of employment by the Company. Orientation training consists of initial health and safety training including general laboratory safety, personal protection and building evacuation. Orientation also includes quality assurance program training, data integrity training, and an overview of the Company's goals, objectives, mission, and vision.

All technical staff receives training to develop and demonstrate proficiency for the methods they perform. New analysts work under supervision until the supervisory staff is satisfied that a thorough understanding of the method is apparent and method proficiency has been demonstrated, through a precision and accuracy study that has been documented, reviewed and approved by the QA Staff. Data from the study is compared to method acceptance limits. If the data is unacceptable, additional training is required. The analyst may also demonstrate proficiency by producing acceptable data through the analysis of an independently prepared proficiency sample.

Individual proficiency is demonstrated annually for each method performed. Data from initial and continuing proficiency demonstrations are archived in the individual's training folder.

4.3 ***Training Documentation***. The human resources department prepares a training file for every new employee. All information related to qualifications, experience, external training

courses, and education are placed into the file. Verification documentation for orientation, health & safety, quality assurance, and ethics training is also included in the file.

Additional training documentation is added to the file as it is developed. This includes documentation of SOP understanding, data for initial and continuing demonstrations of proficiency, performance evaluation study data and notes and attendance lists from group training sessions.

The Quality Assurance Department maintains the employee training database. This database is a comprehensive inventory of training documentation for each individual employee. The database enables supervisors to obtain current status information on training data for individual employees on a job specific basis. It also enables the management staff to identify training documentation in need of completion.

Employee specific database records are created by human resources on the date of hire. Data base fields for job specific requirements such as SOP documentation of understanding and annual demonstration of analytical capability are automatically generated when the supervisor assigns a job responsibility. Employees acknowledge that their SOP responsibilities have been satisfied using a secure electronic process which updates the database record. Reports are produced which summarize the qualifications of individual employees or departments.

5.0 SIGNATORY APPROVALS

Requirement: Procedures have been developed for establishing the traceability of data and documents. The procedure consists of a signature hierarchy, indicating levels of authorization for signature approvals of data and information within the organization. Signature authority is granted for approval of specific actions based on positional hierarchy within the organization and knowledge of the operation that requires signature approval. SOP EQA032 Signature Authority explains the process of SGS Accutest Inc. Signature Authority and the use of electronic signatures in the laboratory. A log of signatures and initials of all employees is maintained by the QA Staff for cross-referencing purposes.

5.1 *Signature Hierarchy*.

President/CEO. Approval of quality assurance policy in lieu of the Director, Quality Assurance. IT Development and Health and Safety purchase approvals in Lieu of IT and H & S managers.

Laboratory Director. Approval of final reports in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. Establishes and implements technical policy.

Vice President, Chief Information Officer. Department specific supplies purchase. MIS policy.

Director, Quality Assurance. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers.

Director, Client Services. QAP and sampling and analysis plan approval. Project specific contracts, pricing, and price modification agreements. Approval and acceptance of incoming work, Client services policy.

Managers, Technical Departments. Methodology and department specific QAPs. Data review and approval, department specific supplies purchase. Technical approval of SOPs.

Manager, Sample Management. Initiation of laboratory sample custody and acceptance of all samples. Approval of department policies and procedures. Department specific supplies purchase.

Director, Environmental Health & Safety. Approval of health and safety policy in the absence of the President. Approval of health and safety SOPs. Waste manifesting and approval.

Assistant Managers: Technical Departments. Data review approval, purchasing of expendable supplies.

Supervisor, Field Services. Sampling plan design and approval. Data review for field parameters. State form certification. Department policies and procedures. Department specific supplies purchase.

Supervisors, Technical Departments. Data review approval, purchasing of expendable supplies.

5.2 ***Signature Requirements***. All laboratory activities related to sample custody and generation or release of data must be approved using either initials, signatures or electronic, password protected procedures. The individual, who applies his signature initial or password to an activity or document, is authorized to do so within the limits assigned to them by their supervisor. All written signatures and initials must be applied in a readable format that can be cross-referenced to the signatures and initials log if necessary.

5.3 ***Signature and Initials Log***. The QA group maintains a signature and initials log. New employee signatures and initials are appended to the log on the first day of employment. Signature of individuals no longer employed by the company are retained, but annotated with their date of termination.

5.4 ***Electronic Signature Log.*** Key technical staff will sign a liability document for their signatures designating the use of their electronic signatures on an annual basis. Quality Assurance team keeps a wet copy of these signatures on form QA115.

6.0 DOCUMENTATION & DOCUMENT CONTROL

Requirement: Document control policies have been established which specify that any document used as an information source or for recording analytical or quality control information must be managed using defined document control procedures. Accordingly, policies and procedures required for the control, protection, and storage of any information related to the production of analytical data and the operation of the quality system to assure its integrity and traceability have been established and implemented in the laboratory. The system contains sufficient controls for managing, archiving and reconstructing all process steps which contributed to the generation of an analytical test result. Using this system, an audit trail for reported data can be produced, establishing complete traceability for the result.

6.1 ***Administrative Records***. Administrative (non-analytical) records are managed by the quality assurance department. These records consist of electronic documents which are retained in a limited access electronic directory or paper documents, which are released to the technical staff upon specific request.

Form Generation, Modification & Control. The quality assurance group approves and manages all forms used as either stand-alone documents or in logbooks to ensure their traceability. Forms are generated as computer files only and are maintained in a limited access master directory. The QA staff also manages and approves modifications to existing forms. Obsolete editions of modified forms are retained for seven years.

Approved forms are assigned a 5-character alphanumeric code. The first two alpha characters designate the department that uses the form; the next three digits are sequentially assigned number.

New forms must include the name SGS Accutest Inc. and appropriate spaces for signatures of approval and dates. Further design specifications are the responsibility of the originating department.

The technical staff is required to complete all forms to the maximum extent possible. If information for a specific item is unavailable, the analyst is required to "Z" the information block. The staff is also required to "Z" the uncompleted portions of a logbook or logbook form if the day's analysis does not fill the entire page of the form.

Logbook Control. All laboratory logbooks are controlled documents that are comprised of approved forms used to document specific processes. New logs are numbered and issued to a specific individual who is assigned responsibility for the log. Old logs are returned to QA for entry into the document archive system where they are retained for seven (7) years. Laboratory staff may hold a maximum of two consecutively dated logbooks of the same type in the laboratory including the most recently issued book to simplify review of recently completed analysis. The Organic prep department maintains multiple active copies of prep logbooks to facilitate production.

Controlled Documents. Key laboratory documents that are distributed internally and externally are numbered for tracking purposes. Individuals receiving documents, who must be informed when changes occur, receive controlled copies of those documents. Controlled status simplifies document updates and retrieval of outdated documents. Control is maintained through a document numbering procedure and document control logbook which identifies the individual receiving the controlled document and the date of receipt. Key documents are also distributed as uncontrolled documents if the recipient does not require updated copies when changes occur. Key documents in uncontrolled status are numbered and tracked using the same procedures as controlled documents.

Quality Systems Manual (QSM). All QSMs are assigned a number prior to distribution. The number, date of distribution, and identity of the individual receiving the document are recorded in the document control logbook. The numbering system is restarted with each new volume, which corresponds to the annual revision of the QSM. Electronic versions are distributed as read only files that are password protected.

Standard Operating Procedures (SOPs). SOPs are maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory. Official documents are copied to green paper and placed into the appropriate laboratory section as follows:

Administrative: One master copy for the administrative file.

Sample Management: One controlled green copy for the sample management file.

Organics Laboratories: Two controlled green copies, one for the affected laboratory area, and one for the organics laboratory file.

Inorganics Laboratories: Two controlled green copies, one for the affected laboratory area, and one for the inorganics laboratory file.

Field Services: One controlled green copy for each field sampling team (generally a single field technician).

The original, signed copy of the SOP is maintained in the master SOP binder by the QA staff. The QA staff collects outdated versions of SOPs as they are replaced and archived for a period of seven (7) years in the QA archives. Electronic versions of outdated SOPs are moved from the active SOP directory to the inactive directory.

6.2 ***Technical Records***. All records related to the analysis of samples and the production of an analytical result are archived in secure document storage or on electronic media and contain sufficient detail to produce an audit trail which re-creates the analytical result. These records include information related to the original client request, bottle order, sample login and custody, storage, sample preparation, analysis, data review and data reporting.

Each department involved in this process maintains controlled documents which enable them to maintain records of critical information relevant to their department's process.

6.3 ***Quality Control Support Data & Records***. All information and data related to the quality system is stored in a restricted access directory on the network server. Information on this directory is backed-up daily. Users of the quality assurance information and data have "read-only" access to the files contained in the directory. The QA staff and the laboratory director have write capability in this directory.

This directory contains all current and archived quality system manuals, SOPs, control limits, MDL studies, precision and accuracy data, official forms, internal audit reports, proficiency test scores and metrics calibration information.

The following information is retained in the directory:

Quality System Manuals
Standard Operating Procedures
ASTM & NIST Methods
Bottleware & Preservative QC Data
Certification Documentation
Change Management Data
External Audit Reports
Internal Audit Reports
Corrective Action Database
Laboratory Forms Directory
Health & Safety Manuals
Inactive Standard Operating Procedures
Method Detection Limit Data
Metrics Inventory & Calibration Data
Performance Limits
Proficiency Test Scores & Statistics
Project Specific Analytical Requirements
QC Report Reviews
Regulatory Agency Quality Documents
Staff Bios And Job Descriptions
State Specific Methods

6.4 ***Analytical Records***. All data related to the analysis of field samples are retained as either paper or electronic records that can be retrieved to compile a traceable audit trail for any reported result. All information is linked to the client job and sample number, which serves as a reference for all sample related information tracking.

Critical times in the life of the sample from collection through analysis to disposal are documented. This includes date and time of collection, receipt by the laboratory, preparation times and dates, analysis times and dates and data reporting information. Analysis times are calculated in hours for methods where holding time is specified in hours (≤72 hours).

Sample preparation information is recorded in a separate controlled logbook. It includes sample identification numbers, types of analysis, preparation and cleanup methods, sample weights and volumes, reagent lot numbers and volumes and any other information pertinent to the preparation procedure.

Information related to the identification of the instrument used for analysis is permanently attached to the electronic record. The record includes an electronic data file that indicates all instrument conditions employed for the analysis, including the type of analysis conducted. The

analyst's identification is electronically attached to the record. The instrument tuning and calibration data is electronically linked to the sample or linked though paper logs which were used in the documentation of the analysis. Quality control and performance criteria are permanently linked to the paper archive or electronic file.
Paper records for the identity, receipt, preparation and evaluation of all standards and reagents used in the analysis are documented in prepared records and maintained in controlled documents or files. Lot number information linking these materials to the analysis performed is recorded in the logbooks associated with the samples in which they were used.

Manual calculations or peak integrations that were performed during the data review are retained as paper or scanned documents and included as part of the electronic archive. Signatures for data review are retained on paper or as scanned versions of the paper record for the permanent electronic file.

6.5 ***Confidential Business Information (CBI).*** Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between SGS Accutest Inc. and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only.

6.6 ***Software Change Documentation & Control.*** Changes to software are documented as text within the code of the program undergoing change. Documentation includes a description of the change, reason for change and the date the change was placed into effect. Documentation indicating the adequacy of the change is prepared following the evaluation by the user who requested the change.

6.7 ***Report and Data Archiving***. SGS Accutest Inc. produces digital files of all raw and processed data which is maintained for a minimum period of seven (7) years. The archived files consist of all raw data files and source documents associated with the analysis of field samples and proficiency test samples. Data files and source documents associated with method calibration and project and method quality control are also archived. After seven years, the files may be discarded unless contractual arrangements exist which dictate different requirements. Client or regulatory agency specific data retention practices are employed for several government organizations such as the Department of Defense and the Massachusetts Department of Environmental Protection that require a retention period of ten (10) years. Data archiving may also be extended up to ten (10) years for specific commercial clients in response to contractual requirements.

Complete date and time stamped PDF reports are generated automatically from the laboratory information management system (LIMS) using the source documents archived on the document server. These source documents are maintained on a document server and

archived to primary and clone tapes. The primary tapes remain on premises while the clone tapes are taken to a secure offsite location for permanent storage. Both the primary and clone tapes remain in storage for the remainder of the archive period.

6.8 ***Training***. The company maintains a training record for all employees that documents that they have received instruction on administrative and technical tasks that are required for the job they perform. Training records for individuals employed by the company are retained for a period of six months following their termination of employment.

Training File Origination. The Human Resources Group (HR) initiates training files. The QA staff, through the Quality Assurance officer, retains the responsibility for the maintenance and tracking of all training related documentation in the file. The file is begun on the first day of employment. Information required for the file includes a copy of the individual's most current resume, detailing work experience and a copy of any college diplomas and transcript(s). Information added on the first day includes documentation of health and safety training, quality assurance training and a signed data integrity training and ethical conduct agreement.

Training documentation, training requirements, analyst proficiency information and other training related support documentation is tracked using a customized database application (Section 4.3). Database extracts provide an itemized listing of specific training requirements by job function. Training status summaries for individual analysts portray dates of completion for job specific training requirements.

6.9 ***Technical Training***. The supervisor of each new employee is responsible for developing a training plan for each new employee. The supervisor evaluates the employees training progress at regular frequencies. Supporting documentation, including demonstration of capability and precision and accuracy studies, which demonstrate an analyst's proficiency for a specific test, are added to the training file as completed. Employees and supervisors verify documentation of understanding (DOU) for all assigned standard operating procedures in the training database. Certificates or diplomas for any off-site training are also added to the file.

7.0 REFERENCE STANDARD TRACEABILITY

Requirement: Documented procedures, which establish traceability between any measured value and a national reference standard, are established by the laboratory as required. All metric measurements are traceable to NIST reference weights or thermometers that are calibrated on a regular schedule. All chemicals used for calibration of a quantitative process are traceable to an NIST reference that is documented by the vendor using a certificate of traceability. The laboratory maintains a documentation system that establishes the traceability links. The procedures for verifying and documenting traceability are documented in standard operating procedures.

7.1 ***Traceability of Metric Measurements - Thermometers***. SGS Accutest Inc. uses NIST thermometers to calibrate commercially purchased thermometers prior to their use in the laboratory and annually thereafter for liquid in glass thermometers or quarterly for electronic temperature measuring devices. If necessary, thermometers are assigned correction factors that are determined during their calibration using an NIST thermometer as the standard. The correction factor is documented in a thermometer calibration database and on a tag attached to the thermometer. The correction factor is applied to temperature measurements before recording the measurement in the temperature log. Calibration of each thermometer is verified and documented on a regular schedule. The NIST thermometer is checked for accuracy by an ISO 17025 approved vendor every five (5) years following the specifications for NIST thermometer calibration verification detailed in the united States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, February2005.

7.2 ***Traceability of Metric Measurements – Calibration Weights***. SGS Accutest Inc. uses calibrated weights, which are traceable to NIST standard weights to calibrate all balances used in the laboratory. Balances are calibrated to specific tolerances within the intended use range of the balance. Calibration checks are required on each day of use. If the tolerance criteria are not achieved, corrective action specified in the balance calibration SOP is applied before the balance can be used for laboratory measurements. Recalibration of all calibration weights is conducted and documented on a biannual basis.

7.3 ***Traceability of Chemical Standards***. All chemicals, with the exception of bulk dry chemicals and acids, purchased as reference standards for use in method calibration must establish traceability to NIST referenced material through a traceability certificate. Process links are established that enable a calibration standard solution to be traced to its NIST reference certificate.

Chemical standards used for analysis must meet the purity specifications of the method. These specifications must be stated in the reagents section of the method SOP.

7.4 ***Assignment of Reagent, Bulk Chemical and Standard Expiration Dates.*** Expiration date information for all purchased standards, prepared standard solutions and selected reagents is provided to SGS Accutest Inc. by the vendor as a condition of purchase. Neat materials, bulk chemicals including solvents, acids and inorganic reagents are not required to be purchased

with expiration dates. An expiration date of five (5) years from the date of receipt shall be established. Prepared solutions are labeled with the expiration date provided by the manufacturer. In-house prepared solutions are assigned expiration dates that are consistent with the method that employs their use unless documented experience indicates that an alternate date can be applied. If alternate expiration dates are employed, their use is documented in the method SOP. Expiration dates for prepared inorganic reagents, which have not exhibited instability, are established at two years from the date of preparation for tracking purposes.

The earliest expiration date has been established as the limiting date for assigning expiration dates to prepared solutions. The assignments of expiration dates that are later than the expiration date of any derivative solution or material are prohibited.

7.5 ***Documentation of Traceability***. Traceability information is documented in individual logbooks designated for specific measurement processes. The quality assurance group maintains calibration documentation for metric references in separate logbooks.

Balance calibration verification is documented in logbooks that are assigned to each balance. The individual conducting the calibration is required to initial and date all calibration activities. Any defects that occur during calibration are also documented along with the corrective action applied and a demonstration of return to control. Annual service reports and certificates are retained on file by the QA staff.

Temperature control is documented in logbooks or an electronic temperature monitoring database assigned to the equipment being monitored. A calibrated thermometer or probe is assigned to each individual item. Uncorrected and corrected measurements are recorded. Logbooks document with the date and initials of the individual conducting the measurement on a daily or as used basis. The temperature database records temperatures automatically every 15 minutes. Corrective action, if required, is also documented including the demonstration of return to control.

Initial traceability of chemical standards is documented via a vendor-supplied certificate (not available for bulk dry chemicals and acids) that includes lot number, expiration date and certified concentration information. Solutions prepared using the vendor supplied chemical standards are documented in logbooks assigned to specific analytical processes. Alternatively, documentation may be entered into the electronic standards and reagent tracking log. The documentation includes links to the vendor's lot number, an internal lot number, and dates of preparation, expiration date, and the preparer's initials.

SGS Accutest Inc. employs commercially prepared standard solutions whose traceability can be demonstrated through a vendor supplied certificate of analysis that includes an experimental verification of the standard's true concentration. The test value for the verification analysis must agree within 1% of the vendor's true value before it can be employed for calibration purposes. If the test value differs from the nominal value by more than 1%, then the test value is used as the true value in laboratory calibrations and calculations. Purchased standards which

do not have a certificate of analysis cannot be used for calibration or calibration verification purposes and are rejected or returned to the vendor.

Supervisors conduct regular reviews of logbooks, which are verified using a signature and date.

8.0 TEST PROCEDURES, METHOD REFERENCES, AND REGULATORY PROGRAMS

Requirements: The laboratory employs client specified or regulatory agency approved methods for the analysis of environmental samples. A list of active methods is maintained, which specifies the type of analyses performed and cross-references the methods to applicable environmental regulations. Routine procedures used by the laboratory for the execution of a method are documented in standard operating procedures. Method performance and sensitivity are demonstrated annually where required. Defined procedures for the use of method sensitivity limits for data reporting purposes are established by the Director of Quality Assurance and used consistently for all data reporting purposes.

8.1 ***Method Selection & Application***. SGS Accutest Inc. employs methods for environmental sample analysis that are consistent with the client's application, which are appropriate and applicable to the project objectives. SGS Accutest Inc. informs the client if the method proposed is inappropriate or outdated and suggests alternative approaches.

SGS Accutest Inc. employs documented, validated regulatory methods in the absence of a client specification and informs the client of the method selected. These methods are available to the client and other parties as determined by the client. Documented and validated in-house methods may be applied if they are appropriate to the project. The client is informed of the method selection.

8.2 ***Standard Operating Procedures***. Standard operating procedures (SOP) are prepared for routine methods executed by the laboratory, processes related to laboratory operations and sample or data handling. All SOPs are formatted to meet the specifications established by the National Environmental Laboratory Accreditation Conference, which are detailed in Chapter Five – Quality Systems of the established Standards. The procedures describe the process steps in sufficient detail to enable an individual, who is unfamiliar with the procedure to execute it successfully.

SOPs are evaluated annually and edited if necessary. Reviewed SOPs that do not require modification include an evaluation summary form indicating that an evaluation was conducted and modifications were not needed. SOPs can be edited on a more frequent basis if changes are required for any reason. These may include a change to the methodology, elimination of systematic errors that dictate a need for process changes or modifications to incorporate a new version of the method promulgated by the originating regulatory agency. Procedural modifications are indicted using a revision number. SOPs are available for client review at the SGS Accutest Inc. facility upon request.

The complete list of the laboratories SOPs available as of the date of publication of this QSM version are detailed in Appendix II.

8.3 ***Method Validation***. Standard methods from regulatory sources are primarily used for all analysis. Standard methods do not require validation by the laboratory. Non-standard, in-

house methods are validated prior to use. Validation is also performed for standard methods applied outside their intended scope of use. Validation is dependent upon the method application and may include analysis of quality control samples to develop precision and accuracy information for the intended use. A final method validation report is generated, which includes all data in the validation study. A statement of adequacy and/or equivalency is included in the report. A copy of the report is archived in the quality assurance directory of the company server.

Non-standard methods are validated prior to use. This includes the validation of modified standard methods to demonstrate comparability with existing methods. Demonstrations and validations are performed and documented prior to incorporating technological enhancements and nonstandard methods into existing laboratory methods used for general applications. The demonstration includes method specific requirements for assuring that significant performance differences do not occur when the enhancement is incorporated into the method. Validation is dependent upon method application and may include the analysis of quality control samples to develop precision and accuracy information for intended use.

The study procedures and specifications for demonstrating validation include comparable method sensitivity, calibration response, method precision; method accuracy and field sample consistency for several classes of analytical methods are detailed in this document. These procedures and specifications may vary depending upon the method and the modification.

8.4 ***Estimated Uncertainty.*** A statement of the estimated uncertainty of an analytical measurement accompanies the test result when required. Estimated uncertainty is derived from the performance limits established for spiked samples of similar matrices. The degree of uncertainty is derived from the negative or positive bias for spiked samples accompanying a specific parameter. When the uncertainty estimate is applied to a measured value, the possible quantitative range for that specific parameter at that measured concentration is defined. Well recognized regulatory methods that specify values for the major sources of uncertainty and specify the data reporting format do not require a further estimate of uncertainty.

8.5 ***Demonstration of Capability***. Confirmation testing is conducted to demonstrate that the laboratory is capable of performing the method before its application to the analysis of environmental samples. The results of the demonstration tests are compared to the quality control specifications of the method to determine if the performance is acceptable.

Capability demonstrations are conducted initially for every analyst on each method performed and annually on a method specific basis thereafter. Acceptable demonstrations are documented for individual training files and retained by the QA staff. New analytes, which are added to the list of analytes for an accredited method, are evaluated for applicability through a demonstration of capability similar to those performed for accredited analytes.

8.6 ***Method Detection Limit Determination***. Annual method detection limit (MDL) studies are performed as appropriate for routine methods used in the laboratory. MDL studies are also performed when there is a change to the method that affects how the method is performed or when an instrumentation change that impacts sensitivity occurs. The procedure used for

determining MDLs is described in 40 CFR, Part 136, and Appendix B. Studies are performed for each method on water, soil and air matrices for every instrument that is used to perform the method. MDLs are established at the instrument level. The highest MDL of the pooled instrument data is used to establish a laboratory MDL. MDLs are experimentally verified through the analysis of spiked quality control samples at 1-4 times the concentration of the experimental MDL. The verification is performed on every instrument used to perform the analysis. The quality assurance staff manages the annual MDL determination process and is responsible for retaining MDL data on file. Approved MDLs are appended to the LIMS and used for data reporting purposes.

8.7 ***Limit of Detection (LOD).*** For the DoD ELAP the limit of detection (LOD) for each method and target analyte of concern is established for each instrument that is used to perform the method. The LOD is established by initially spiking a water and/or soil matrix at approximately two to three times the calculated MDL (for a single-analyte standard) or two to four times the calculated MDL (for a multi-analyte standard). The LOD undergoes all sample processing steps and is validated by the qualitative identification of the analytes of interest. The spike concentration establishes the LOD and must be verified quarterly. If the spike concentration in the LOD cannot be verified at the initial level with appropriate analytical quality control, a higher LOD must be defined and verified.

8.8 ***Instrument Detection Limit Determination***. Instrument detection limits (IDLs) are determined for all inductively coupled argon plasma emission spectrophotometers and mass spectrometers. The IDL is determined for the wavelength (emission) of each element and the ion (mass spectrometry) of each element used for sample analysis. The IDL data is used to estimate instrument sensitivity in the absence of the sample matrix. IDL determinations are conducted at the frequency specified in the appropriate SOPs' for ICP and ICP/MS analysis.

8.9 ***Method Reporting Limit.*** The method reporting limit for organic methods is determined by the concentration of the lowest calibration standard in the calibration curve. This value is adjusted based on several sample preparation factors including sample volume, moisture content (soils), digestion, distillation or dilution. The low calibration standard is selected by department managers as the lowest concentration standard that can be used for calibration while continuing to meet the calibration linearity criteria of the method being used. The validity of the method reporting limits are confirmed through the analysis of a spiked quality control sample at the method reporting limit concentration. By definition, detected analytes at concentrations below the low calibration standard cannot be accurately quantitated and are qualified as estimated values.

The reporting limit for inorganics methods is defined as the concentration which is greater than the MDL where method quality control criteria has been achieved. The reporting limit for general chemistry methods employing multiple point calibrations must be greater than or equal to the concentration of the lowest standard of the calibration range.

The reporting limit established for both organic and inorganic analysis is above the calculated method detection limit where applicable.

8.10 ***Limit of Quantitation (LOQ).*** For the DoD ELAP the limit of quantitation (LOQ) for each analyte of concern is determined. The LOQ is set within the range of calibration is greater than the established LOD. Precision and bias criteria for the LOQ are established to meet client requirements and are verified quarterly.

8.11 ***Reporting of Quantitative Data.*** Analytical data for all methods is reported without qualification to the reporting limit established for each method. Data, for organic methods may be reported to the established method detection limit depending upon the client's requirements provided that all qualitative identification criteria for the detected parameter have been satisfied. All parameters reported at concentrations between the reporting limit and the method detection limit are qualified as estimated.

Data for inorganic methods are reported to the established method reporting limits. Inorganic data for specific methods may also be reported to the established method detection limit at client request. However, this data is always qualified as estimated.

Measured concentrations of detected analytes that exceed the upper limit of the calibration range are either diluted into the range and reanalyzed or qualified as an estimated value. The only exception to this applies to ICP and ICP/MS analysis, which can be reported to the upper limit of the experimentally determined linear range without qualification.

8.12 ***Precision and Accuracy Studies***. Annual precision and accuracy (P&A) studies, which demonstrate the laboratories ability to generate acceptable data, are performed for all routine methods used in the laboratory. The procedure used for generating organic P&A data is referenced in the majority of the regulatory methodology in use. The procedure requires quadruplicate analysis of a sample spiked with target analytes at a concentration in the working range of the method. This data may be compiled from a series of existing blank spikes or laboratory control samples. Accuracy (percent recovery) of the replicate analysis is averaged and compared to established method performance limits. Values within method limits indicate an acceptable performance demonstration. Precision and accuracy date is also used to annually demonstrate analytical capability for individual analysts. Annual demonstration of capability data is archived in individual training files.

Performance Limits. The Quality Assurance Director is responsible for compilation and maintenance of all precision and accuracy data used for performance limits. Quality control data for all test methods are accumulated and stored in the laboratory information management system (LIMS). Parameter specific QC data are extracted semi-annually for methods 8260, 8270, 8081, 8082 and annually for remaining methods. Each method is statistically processed to develop laboratory specific warning limits and control limits. The new limits are reviewed and approved by the supervisory staff prior to their use for data assessment. The new limits are used to evaluate QC data for compliance with method requirements for a period of one year. Laboratory generated limits appear on all data reports.

8.13 ***Method Sources & References.*** The Quality Assurance Staff maintains a list of active methods used for the analysis of samples. This list includes valid method references from

sources such as USEPA, ASTM or Standard Methods designations and the current version and version date.

Updated versions of approved reference methodology are placed into use as changes occur. The Quality Assurance Director informs operations management of changes in method versions as they occur. The operations management staff selects an implementation date. The operations staff is responsible for completing all method use requirements prior to the implementation date. This includes modification of SOPs, completion of MDL and precision and accuracy studies and staff training. Documentation of these activities is provided to the QA staff who retains this information on file. The updated method is placed into service on the implementation date and the old version is de-activated.

Multiple versions of selected methods may remain in use to satisfy client specific needs. In these situations, the default method version becomes the most recent version. Client specific needs are communicated to the laboratory staff using method specific analytical method codes, which clearly depict the version to be used. The old method version is maintained as an active method until the specified client no longer requires the use of the older version.

SGS Accutest Inc. will not use methodology that represents significant departures from the reference method unless specifically directed by the client. If clients direct the laboratory to use a method modification that represents a significant departure from the reference method, the request will be documented in the project file.

8.14 ***Analytical Capabilities***. Appendix III provides a detailed listing of the methodology employed for the analysis of test samples.

9.0 SAMPLING, SAMPLE MANAGEMENT, LOGIN, CUSTODY, STORAGE AND DISPOSAL

Requirement: The laboratory must employ a system which ensures that client supplied product or supplied product (the sample) is adequately evaluated, acknowledged, and secured upon delivery to the laboratory. The system also assures that product chain of custody is maintained and that sample receipt conditions and preservation status are documented and communicated to the client and internal staff. The login procedure assigns, documents, and maps the specifications for the analysis of each unique sample to assure that the requested analysis is performed on the correct sample and enables the sample to be tracked throughout the laboratory analytical cycle. The system includes procedures for reconciling defects in sample condition or client provided data, which are identified at sample arrival. The system specifies the procedures for proper sample storage, transfer to the laboratory, and disposal after analysis. The system is also documented in standard operating procedures.

9.1 ***Order Receipt and Entry***. New orders are initiated and processed by the client services group (See Chapter 14, Procedures for Executing Client Specifications). The new order procedure includes mechanisms for providing bottles to clients, which meet the size, cleanliness, and preservation specifications for the analysis to be performed.

For new orders, the project manager prepares a bottle request form, which is submitted to sample management. This form provides critical project details to the sample management staff, which are used to prepare and assemble the sample bottles for shipment to the client prior to sampling.

The bottle order is assembled using bottles that meet USEPA specifications for contaminant free sample containers. SGS Accutest Inc. uses a combination of commercially supplied pre-cleaned bottles and bottles that have been tested for residual contamination and verified to meet USEPA specifications prior to use. Sterile bottles for microbiological samples are purchased from commercial sources.

Bottles, which are not purchased pre-cleaned, are checked to assure that they are free of contamination from targeted analytes before being released for use. Sterile bottles are checked for contamination with each lot. The QA staff retains a copy of the documentation of in-house contamination and sterility checks and maintains the responsibility for approving and releasing bottle lots for use following a review of the check data.

Preservative solutions that are specified for the analysis requested are dispensed into the sample bottle prior to shipment. All preservative solutions are prepared in the laboratory or purchased from commercial suppliers. Each solution is checked to assure that it is free of contamination from the compounds being analyzed before being released for use.

Reagent water for trip and field blanks is poured into appropriately labeled containers. All bottles are packed into ice chests with blank chain of custody forms and the original bottle

order form. Completed bottle orders are delivered to clients using SGS Accutest Inc. couriers or commercial carriers for use in field sample collection.

9.2 ***Sampling***. Documented procedures are employed by the field staff for field sample collection and are accessible during sample collection activities. Field activities are documented in controlled notebooks which detail relevant field conditions, site data and the results of field measurements. Appropriate custody procedures for collected samples are initiated by the field staff at the time of sample collection. Samples are documented, labeled and preserved according to the specifications of the method and/or regulatory program prior to being shipped to the laboratory.

9.3 ***Sample Receipt and Custody***. Samples are delivered to the laboratory using a variety of mechanisms including SGS Accutest Inc. couriers, commercial shippers, and client self-delivery. Documented procedures are followed for arriving samples to assure that custody and integrity are maintained and handling/ preservation requirements are documented and maintained.

Sample custody documentation is initiated when the individual collecting the sample collects field samples. Custody documentation includes all information necessary to provide an unambiguous record of sample collection, sample identification, and sample collection chronology. Initial custody documentation employs either SGS Accutest Inc. or client generated custody forms.

SGS Accutest Inc. generates a chain of custody in situations where the individuals who collected the sample did not generate custody documentation in the field.

SGS Accutest Inc. defines sample custody as follows:

∴ The sample is in the actual custody or possession of the assigned responsible person,

∴ The sample is in a secure area.

The SGS Accutest Inc. facility is defined as a secure facility. Perimeter security has been established, which limits access to authorized individuals only. Visitors enter the facility through the building lobby and must register with the receptionist prior to entering controlled areas. While in the facility, visitors are required to wear a visitor's badge and must be accompanied by their hosts at all times. After hours, building access is controlled using a computerized passkey reader system. This system limits building access to individuals with a pre-assigned authorization status. After hours visitors are not authorized to be in the building. Clients delivering samples after hours must make advanced arrangements through client services and sample management to assure that staff is available to take delivery and maintain custody.

Upon arrival at SGS Accutest Inc., the sample custodian reviews the chain of custody for the samples received to verify that the information on the form corresponds with the samples

delivered. This includes verification that all listed samples are present and properly labeled, checks to verify that samples were transported and received at the required temperature, verification that the sample was received in proper containers, verification that sufficient volume is available to conduct the requested analysis, and a check of individual sample containers to verify test specific preservation requirements including the absence of headspace for volatile compound analysis.
Sample conditions and other observations are documented on the chain of custody by the sample custodian prior to completing acceptance of custody and in an online database that creates a permanent record of all sample login activities. The sample custodian accepts sample custody upon verification that the custody document is correct. Discrepancies or non-compliant situations are documented and communicated to the SGS Accutest Inc. project manager, who contacts the client for resolution. The resolution is documented and communicated to sample management for execution.

The sample management staff maintains an electronic sample receipt log. This log details all sample-related information in a searchable database that is updated upon data entry and backed up daily. The log records include critical date information, numbers of samples, numbers of bottles for each parameter, descriptions of bottles for each parameter, preservation conditions, bottle refrigerator location, and bottle conditions. Data entry into the log is secured using individual passwords.

During initial login, each bottle is assigned a unique number and is labeled with a barcode corresponding to that number. A bar-coding and scanning system electronically tracks sample custody transfers between individuals within the laboratory. Internal custody documentation may be required for compliance with regulatory agency or contractual specifications. A documented, chronological record of each sample transfer identifying each individual having possession of the sample is created in the laboratory information management system, which can be printed and included in data reports to demonstrate continuous custody.

9.4 ***Laboratory Preservation of Improperly Preserved Field Samples.*** SGS Accutest Inc. will attempt to preserve field samples that were received without proper preservation to the extent that it is feasible and supported by the methods in use. Laboratory preservation of improperly preserved or handled field samples is routinely performed for metals samples. Special handling procedures may also be applied to improperly preserved volatile organics.

Aqueous metals samples that were not nitric acid preserved to pH 2 in the field are laboratory preserved and held for twenty (24) hours to equilibrate prior to analysis. Aqueous metals samples requiring field filtration may be filtered in the laboratory within seventy-two (72) hours of receipt provided that the sample has not been acid preserved.

Unpreserved volatile organics samples may be analyzed within seven (7) days to minimize degradation of volatile organics if the laboratory is notified in advance of the failure to preserve upon collection. Laboratory preservation of unpreserved aqueous samples is not possible. A pH check of volatile organic samples prior to analysis will compromise the sample by allowing volatile organics to escape during the check. If the laboratory is not notified of the failure to field

preserve an aqueous volatile organic sample, the defect will not be identified until sample analysis has been completed and the data is qualified accordingly.

9.5 ***Sample Tracking Via Status Change.*** An automated, electronic LIMS procedure records sample exchange transactions between departments and changes in analytical status. This system tracks all preparation, analytical, and data reporting procedures to which a sample is subjected while in the possession of the laboratory. Each individual receiving samples must acknowledge the change in custody and operational status in the LIMS. This step is required to maintain an accurate electronic record of sample status, dates of analytical activity, and custody throughout the laboratory.

Sample tracking is initiated at login where all chronological information related to sample collection dates and holding times are entered into the LIMS. This information is entered on an individual sample basis.

9.6 ***Sample Acceptance Policy***. Incoming samples must satisfy SGS Accutest Inc.'s sample acceptance criteria before being logged into the system. Sample acceptance is based on the premise that clients have exercised proper protocols for sample collection. This includes complete documentation, sufficient volume, proper chemical preservation, temperature preservation, sample container sealing and labeling, and appropriate shipping container packing.

The sample management staff will make every attempt to preserve improperly preserved samples upon arrival. However, if preservation is not possible, the samples may be refused unless the client authorizes analysis. No samples will be accepted if holding times have been exceeded or will be exceeded before analysis can take place unless the client authorizes analysis.

Sample acceptance criteria include proper custody and sample labeling documentation. Proper custody documentation includes an entry for all physical samples delivered to the laboratory with an identification code that matches the sample bottle and a date and signature of the individual who collected the sample and delivered them to the laboratory.

SGS Accutest Inc. reserves the right to refuse any sample which in its sole and absolute discretion and judgment is hazardous, toxic and poses or may pose a health, safety or environmental risk during handling or processing. The company will not accept samples for analysis using methodology that is not performed by the laboratory or for methods that lab does not hold valid accreditations unless arrangements have been made to have the analysis conducted by a qualified subcontractor.

SGS Accutest Inc. does not accept radioactive samples, however, the policy for sample handling of Naturally Occurring Radioactive Materials (NORM) is described below:

Samples that meet the Federal Department of Transportation and International Air Transportation Association criteria could be accepted and handled following normal procedures (except for disposal) in the lab. This corresponds to samples with United Nations

(UN) labels indicating levels of < 500 uR/hour. Samples containing levels at or higher than 500 uR/hour will not be accepted by SGS Accutest Inc. Clients must inform SGS Accutest Inc. of the level of radiation by screening the samples and documenting the level on the Chain of Custody or other form in order for the samples to be accepted.

SGS Accutest Inc. would require that any shipments containing samples of this type must be clearly labeled with UN labels showing the measured level of radioactivity as < 500 uR/hour.

These samples cannot be disposed of in our normal waste streams. Therefore, on completion of analysis, the samples would be returned to the client or disposed of using an alternate waste handler. In either case, the client would be responsible for the additional shipping or disposal charges, as well as processing charges for segregating the waste stream in the lab.

9.7 ***Assignment of Unique Sample Identification Codes***. Unique identification codes are assigned to each sample bottle to assure traceability and unambiguously identify the tests to be performed in the laboratory.

The sample identification coding process begins with the assignment of a unique alphanumeric job number. A job is defined as a group of samples received on the same day, from a specific client pertaining to a specific project. A job may consist of groups of samples received over a multi-day period. The first two characters of the job number are alpha-characters that identify the laboratory facility. The next characters are numeric and sequence by one number with each new job.

Unique sample numbers are assigned to each bottle collected as a discrete entity from a designated sample point. This number begins with the job number and incorporates a second series of numbers beginning at one and continuing chronologically for each point of collection. The test to be performed is clearly identified on the bottle label. Multiple sample bottles collected for analysis of the same parameter are numbered bottle 1, 2, etc.

Alpha suffixes may be added to the sample number to identify special designations such as subcontracted tests, in-house QC checks, or re-logs. Multiple sample bottles for a specific analysis are labeled Bottle 1, Bottle 2, etc.

9.8 ***Subcontracted Analysis***. Subcontract laboratories are employed to perform analysis not performed by SGS Accutest Inc. The quality assurance staff evaluates subcontract laboratories to assure their quality processes meet the standards of the environmental laboratory industry prior to engagement. Throughout the subcontract process, SGS Accutest Inc. follows established procedures to assure that sample custody is maintained and the data produced by the subcontractor meets established quality criteria.

*Subcontracting Procedure***.** Subcontracting procedures are initiated through several mechanisms, which originate with sample management. Samples for analysis by a subcontractor are logged into the SGS Accutest Inc. system using regular login procedures. If subcontract parameters are part of the project or sample management has received subcontracting instructions for a

specific project, a copy of the chain of custody is given to the appropriate project manager with the subcontracted parameters highlighted. This procedure triggers the subcontract process at the project management level. The project manager contacts an approved subcontractor that carries accreditation in the venue of the project location to place the subcontract order. A subcontract order form (SOF) is simultaneously prepared in electronic format, by the project manager and filed with the original chain of custody. The SOF and the subcontract chain of custody are forwarded to sample management, via E-Mail, for processing. A copy is filed with the original CoC.

Sample management signs the subcontract chain of custody and ships the sample(s) to the subcontractor. The subcontract CoC is filed with the original CoC and the request for subcontract. Copies are distributed to the login department, the project manager, sample management and the client.

Clients are verbally notified of the need to subcontract analysis as soon as the need is identified by the client services staff. This may occur during the initial project setup or at the time of login if the project setup had not been initiated through the client services staff. Copies of the subcontract CoC and the original CoC, which are electronically distributed to clients, constitutes documented client notification of the laboratories intent to subcontract analysis.

Subcontractor data packages are reviewed by the QA Staff to assess completeness and quality compliance. If completeness defects are detected, the subcontractor is asked to immediately upgrade the data package. If data quality defects are detected, the QA staff retains the package for further review. The QA staff will pursue a corrective action solution before releasing defective data to the client.

Approved subcontract data is entered into the laboratory information management system (LIMS) if possible and incorporated into the final report. All subcontract data is footnoted to provide the client with a clear indication of its source. Copies of original subcontract data are included in the data report depending on the reporting level specified by the client. Applicable subcontractor accreditation information is provided with the subcontractor data.

*Subcontract Laboratory Evaluation***.** The QA staff evaluates subcontract laboratories prior to engagement. The subcontract laboratory must provide SGS Accutest Inc. with proof of a valid certification to perform the requested analysis for the venue where they were collected and for a specific program should an approval or accreditation be required. In addition, the QA staff may require a copy of the laboratory's Quality Systems Manual, copies of SOPs used for the subcontracted analysis, a copy of the most recent performance evaluation study for the subcontracted parameter, copies of the internal data integrity policy and copies of the most recent regulatory agency or third party accreditor audit report. Certification verification must be submitted to SGS Accutest Inc. annually. If possible, the QA staff may conduct a site visit to the laboratory to inspect the quality system. SGS Accutest Inc. assumes the responsibility for the performance of all subcontractors who have successfully demonstrated their qualifications and should obtain an example data deliverable package prior to initiation of

subcontract work for compliance review. Qualification of a subcontract laboratory may be bypassed if the primary client directs SGS Accutest Inc. to employ a specific subcontractor.

9.9 ***Sample Storage***. Following sample transfer to the sample custodian, samples are assigned to various secured, refrigerated storage areas depending upon the test to be performed and the matrix of the samples. The location (refrigerator and shelf) of each sample is recorded on the chain of custody adjacent to the line corresponding to each sample number and also entered into the LIMS. Samples remain in storage until the laboratory technician requests that they be transferred into the laboratory for analysis.

Second shift staff is authorized to retrieve samples from storage and initiate custody transfer. All sample request forms must be completed regardless of who performs the transfer.

Samples for volatile organics analysis are placed in storage in designated refrigerators by the sample custodian and immediately transferred to the organics group control. Sample custody is transferred to the department designee. These samples are segregated according to matrix to limit opportunities for cross contamination to occur.

Organics staff is authorized to retrieve samples from these storage areas for analysis. When analysis is complete, the samples are placed back into storage.

9.10 ***Sample Login***. Following sample custody transfer to the laboratory, the documentation that describes the clients analytical requirements are delivered to the sample login group for coding and entry to the Laboratory Information Management System (LIMS). This process translates all information related to collection time, turnaround time, sample analysis, and deliverables into a code which enables client requirements to be electronically distributed to the various departments within the laboratory for scheduling and execution.

The technical staff is alerted to client or project specific requirements through the use of a unique project code that is electronically attached to the job during login. The unique project code directs the technical staff to controlled specifications documents detailing the unique requirements.

9.11 ***Sample Retrieval for Analysis***. Individual laboratory departments prepare and submit written requests to the sample custodian to retrieve samples for analysis. The sample custodian retrieves all samples except volatile organics and delivers them to the requesting department. Retrieval priorities are established by the requesting department and submitted to the sample custodian when multiple requests are submitted. Internal custody transfers using the bar code scanning system occur whenever the samples change hands or locations.
After sample analysis has been completed, the department requests pick-up and return of the sample to the storage area. The sample custodian retrieves the sample and completes the custody transfer from the department of the transfer back to sample management or sample storage.

9.12 ***Sample Disposal***. SGS Accutest Inc. retains all samples and sample extracts under proper storage for a minimum of 30 days following completion of the analysis report. Longer storage periods are accommodated on a client specific basis if required. Samples may also be returned to the client for disposal.
SGS Accutest Inc. disposes of all laboratory wastes following the requirements of the Resource Conservation and Recovery Act (RCRA). The Company has obtained and maintains a waste generator identification number, NJD982533622.

Sample management generates a sample disposal dump sheet from the LIMS tracking system each week, which lists all samples whose holding period has expired. Data from each sample is compared to the hazardous waste criteria established by the New Jersey Department of Environmental Protection (NJDEP).

Samples containing constituents at concentrations above the criteria are labeled as hazardous and segregated into five general waste categories for disposal as follows:

- Waste Oil
- Soil (solids – positive and negative hazardous characteristics)
- Mixed Aqueous
- Sludges (semi-solids)
- PCB Hazardous Waste (USEPA 40 CFR 761 criteria).

Non-hazardous aqueous samples are diluted and disposed directly into the laboratory sink. All aqueous liquids pass through a neutralization system before entering the municipal system. Solid samples are emptied into consolidation drums and disposed as hazardous waste or non-hazardous wastes depending upon the results of hazardous characteristics determination. Samples classified as PCB hazardous wastes are labeled and packaged according to the requirements in 40 CFR 761.

Empty glass and plastic bottles from aqueous and solid samples are segregated for recycling. Recycled materials are collected by a commercial contractor and transferred to a county transfer facility for separation into various materials categories. These operations are classified as secure facilities employing cameras, security guards and fiber optic security systems.
The recyclable material is transported to a recycling facility for further processing. Separated glass is transported to a processing facility where it is acid washed in two, separate wash baths, rinsed in boiling water and ground into ½ inch chunks. The chunks are transported to an end product user for re-manufacturing into a glass product.

Separated plastic is transported to a processing facility where it is acid washed to remove the labels and adhesives and boiled for sterilization. The sample containers and any remaining labels are shredded and ground resulting in complete destruction of remaining labels the ground material is sent by rail car or tractor-trailer to various end users that melt and reform the material into useful products of their industry. The recycling facility employs a Code of Ethics in which all client names are confidential and are not divulged to any individual or corporation without written permission from the client.

Laboratory wastes are collected by waste stream in designated areas throughout the laboratory. Waste streams are consolidated twice each week by the waste custodian and transferred to stream specific drums for disposal through a permitted waste management contractor. Filled, consolidated drums are tested for hazardous characteristics and scheduled for removal from the facility for appropriate disposal based on the laboratory data.

All solvent extracts and digestates are collected for disposal following the thirty-day holding period and drummed according to their specific waste stream category. Chlorinated solvent extracts are drummed as chlorinated wastes (i.e., Methylene Chloride). Non-chlorinated solvent extracts are drummed as non-chlorinated wastes (i.e., acetone, hexane, methanol, and mixed solvents). Digestates are collected for disposal following the thirty-day holding period and drummed as corrosive liquid containing metals.

10.0 LABORATORY INSTRUMENTATION AND MEASUREMENT STANDARDS

Requirement: The laboratory has established procedures, which assure that instrumentation is performing to a pre-determined operational standard prior to the analysis of any samples. In general, these procedures follow the regulatory agency requirements established in promulgated methodology. The instrumentation selected to perform specified analysis are uniquely identified and capable of providing the method specified uncertainty of measurement needed. These procedures are documented and incorporated into the standard operating procedures for the method being executed.

10.1 ***Mass Tuning – Mass Spectrometers***. The mass spectrometer tune and sensitivity is monitored to assure that the instrument is assigning masses and mass abundances correctly and that the instrument has sufficient sensitivity to detect compounds at low concentrations. This is accomplished by analyzing a specific mass tuning compound at a fixed concentration. If the sensitivity is insufficient to detect the tuning compound, corrective action must be performed prior to the analysis of standards or samples. If the mass assignments or mass abundances do not meet criteria, corrective action must be performed prior to the analysis of standards or samples.

10.2 ***Wavelength Verification – Spectrophotometers***. Spectrophotometer detectors are checked on a regular schedule to verify proper response to the wavelength of light needed for the test in use. If the detector response does not meet specifications, corrective action (detector adjustment or replacement) is performed prior to the analysis of standards or samples.

10.3 ***Inter-element Interference Checks (Metals)***. Inductively Coupled Plasma Emission Spectrophotometers (ICP) are subject to a variety of spectral interferences, which can be minimized or eliminated by applying interfering element correction factors and background correction points. Interfering element correction factors are checked on a specified frequency through the analysis of check samples containing high levels of interfering elements. Analysis of single element interferant solutions is also conducted at a specified frequency.

If the check indicates that the method criteria have not been achieved for any element in the check standard, the analysis is halted and data from the affected samples are not reported. Sample analysis is resumed after corrective action has been performed and the correction factors have been re-calculated.

New interfering element correction factors are calculated and applied whenever the checks indicate that the correction factors are no longer meeting criteria. At a minimum, correction factors are replaced once a year.

Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) also is subject to isobaric elemental and polyatomic ion interferences. These interferences are corrected through the use of calculations. The accuracy of corrections is dependent on the sample matrix and instrument conditions and is verified by quality control checks on individual runs.

10.4 ***Calibration and Calibration Verification***. Many tests require calibration using a series of reference standards to establish the concentration range for performing quantitative analysis. Instrument calibration is performed using standards that are traceable to national standards. Method specific procedures for calibration are followed prior to any sample analysis. In general, if a reference method does not specify the number of calibration standards, the minimum number is two (one of which is at the reporting limit or limit of quantitation).

Calibration is performed using a linear regression calculation or calibration factors calculated from the curve. The calibration must meet method specific criteria for linearity or precision. If the criteria are not achieved, corrective action (re-calibration or instrument maintenance) is performed. The instrument must be successfully calibrated before analysis of samples can be conducted.

Initial calibration for metals analysis performed using inductively coupled plasma (ICP) employs the use of a single standard and a calibration blank to establish linearity. Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) can be calibrated using either a two point or a multi-point calibration, as long as all quality control criteria for the analysis can be achieved. The calibration blank contains all reagents that are placed into the calibration standard with the exception of the target elements. Valid calibration blanks must not contain any target elements.

Initial calibrations must be verified using a single concentration calibration standard from a second source (i.e. separate lot or different provider). The continuing validity of existing calibrations must be regularly verified using a single calibration standard. The response to the standard must meet pre-established criteria that indicate the initial calibration curve remains valid. If the criteria are not achieved corrective action (re-calibration) is performed before any additional samples may be analyzed.

If continuing calibration verification results are outside established criteria, data associated with the verification may be fully useable under the following conditions:

- When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported.

- When the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level.

Calibration verification is also performed whenever it appears that the analytical system is out of calibration or no longer meets the calibration requirements. It is also performed when the time period between calibration verifications has expired.

Sample results are quantitated from the initial instrument calibration unless otherwise required by regulation, method, or program specific criteria.

10.5 ***Linear Range Verification and Calibration (ICP & ICP/MS Metals)***. Linear range verification is performed for all ICP and ICP/MS instrumentation. The regulatory program or analytical method specifies the verification frequency. A series of calibration standards are analyzed over a broad concentration range. The data from these analyses are used to determine the valid analytical range for the instrument. ICP instrument calibration is routinely performed using a single standard at a concentration within the linear range and a blank.

Some methods or analytical programs require a low concentration calibration check to verify that instrument sensitivity is sufficient to detect target elements at the reporting limit. The analytical method or regulatory program defines the criteria used to evaluate the low concentration calibration check. If the low calibration check fails criteria, corrective action is performed and verified through reanalysis of the low concentration calibration check before continuing with the field sample analysis. . ICP-MS instrument calibration is normally performed using multiple standards within the linear range and a blank, but may be done with a single standard at a concentration within the linear range and a blank.

10.6 ***Retention Time Development and Verification (GC)***. Chromatographic retention time windows are developed for all analysis performed using gas chromatographs with conventional detectors. An initial experimental study is performed, which establishes the width of the retention window for each compound. The retention time width of the window defines the time ranges for elution of specified target analytes on the primary and confirmation columns. Retention time windows are established upon initial calibration, applying the retention time range from the initial study to each target compound. Retention times are regularly confirmed through the analysis of an authentic standard during calibration verification. If the target analytes do not elute within the defined range during calibration verification, the instrument must be recalibrated and new windows defined. New studies are performed when major changes, such as column replacement are made to the chromatographic system.

10.7 ***Equipment List.*** See Appendix IV for a listing of all equipment used for measurement and/or calibration in laboratory processes.

11.0 INSTRUMENT MAINTENANCE

Requirement. Documented procedures have been established for conducting equipment maintenance. The procedure includes maintenance schedules if required or documentation of daily maintenance activities. All instrument maintenance activities are documented in instrument specific logbooks.

11.1 ***Routine, Daily Maintenance***. Routine, daily maintenance is required on an instrument specific basis and is performed each time the instrument is used. Daily maintenance includes activities to insure a continuation of good analytical performance. This may include performance checks that indicate if non-routine maintenance is needed. If performance checks indicate the need for higher level maintenance, the equipment is taken out of service until maintenance is performed. Analysis cannot be continued until all performance checks meet established criteria and a return to operational control has been demonstrated and documented. The individual assigned to the instrument is responsible for daily maintenance.

11.2 ***Non-routine Maintenance***. Non-routine maintenance is initiated for catastrophic occurrences such as instrument failure. The need for non-routine maintenance is indicated by failures in general operating systems that result in an inability to conduct required performance checks or calibration. Equipment in this category is taken out of service, tagged accordingly and repaired before attempting further analysis. Before initiating repairs, all safety procedures for safe handling of equipment during maintenance, such as lock-out/tag-out are followed. Analysis is not resumed until the instrument meets all operational performance check criteria, is capable of being calibrated and a return to operational control has been demonstrated and documented. Section supervisors are responsible for identifying non-routine maintenance episodes and initiating repair activities to bring the equipment on-line. This may include initiating telephone calls to maintenance contractors if necessary. They are responsible for documenting all details related to the occurrence and repair.

11.3 ***Scheduled Maintenance***. Modern laboratory instrumentation rarely requires regular preventative maintenance. If required, the equipment is placed on a schedule, which dictates when maintenance is needed. Examples include annual balance calibration by an independent provider or ICP preventative maintenance performed by the instrument manufacturer. Section supervisors are responsible for initiating scheduled maintenance on equipment in this category. Scheduled maintenance is documented using routine documentation practices.

11.4 ***Maintenance Documentation***. Routine and non-routine maintenance activities are documented in logbooks assigned to instruments and equipment used for analytical measurements. The logbooks contain preprinted forms, which specify the required maintenance activities. The analyst or supervisor performing or initiating the maintenance activity is required to check the activity upon its completion and initial the form. This includes documenting that the instrument has been returned to operational control following the completion of the activity. Non-routine maintenance (repairs, upgrades) is documented on the back page of the service log.

12.0 QUALITY CONTROL PARAMETERS, PROCEDURES, AND CORRECTIVE ACTION

Requirement: All procedures used for test methods incorporate quality control parameters to monitor elements that are critical to method performance. Each quality parameter includes acceptance criteria that have been established by regulatory agencies for the methods in use. Criteria may also be established through client dictates or through the accumulation and statistical evaluation of internal performance data. Data obtained for these parameters during routine analysis must be evaluated by the analyst, and compared to the method criteria in use. If the criteria are not achieved, the procedures must specify corrective action and conformation of control before proceeding with sample analysis. QC parameters, procedures, and corrective action must be documented within the standard operating procedures for each method. In the absence of client specific objectives the laboratory must define qualitative objectives for completeness and representativeness of data.

12.1 ***Procedure***. Bench analysts are responsible for methodological quality control and sample specific quality control. Each method specifies the control parameters to be employed for the method in use and the specific procedures for incorporating them into the analysis. These control parameters are analyzed and evaluated with every designated sample group (batch).

The data from each parameter provides the analyst with critical decision making information on method performance. The information is used to determine if corrective action is needed to bring the method or the analysis of a specific sample into compliance. These evaluations are conducted throughout the course of the analysis. Each control parameter is indicative of a critical control feature. Failure of a methodological control parameter is indicative of either instrument or batch failure. Failure of a sample control parameter is indicative of control difficulties with a specific sample or samples.

Sample Batch. All samples analyzed in the laboratory are assigned to a designated sample batch, which contains all required quality control samples and a defined maximum number of field samples that are prepared and/or analyzed over a defined time period. The maximum number of field samples in the batch is 20. SGS Accutest Inc. has incorporated the TNI Standard batching policy as the sample-batching standard. This policy incorporates the requirement for blanks and spiked blanks as a time based function as defined by TNI Standard. Accordingly, the specified time period for a sample batch is 24 hours. Matrix spike/matrix spike duplicate, matrix spikes and duplicates are defined as sample frequency based functions and may be applied to several batches until the frequency requirement has been reached. A matrix spike/matrix spike duplicate, matrix spikes and/or duplicate is required every 20 samples.

Client criteria that defines a batch as a time based function which includes a matrix spike/matrix spike duplicates as a contractual specification will be honored. The typical batch contains a blank and a laboratory control sample (LCS or spiked blank). Batch documentation includes lot specifications for all reagents and standards used during preparation of the batch.

12.2 ***Methodological Control Parameters and Corrective Action***. Prior to the analysis of field samples the analyst must determine that the method is functioning properly. Specific control parameters indicate whether critical processes meet specified requirements before continuing with the analysis. Method specific control parameters must meet criteria before sample analysis can be conducted. Each of these parameters is related to processes that are under the control of the laboratory and can be adjusted if out of control.

Method Blank. A method blank is analyzed during the analysis of any field sample. The method blank is defined as a sample. It contains the same standards (internal standards, surrogates, matrix modifiers, etc.) and reagents that are added to the field sample during analysis, with the exception of the sample itself. If the method blank contains target analytes(s) at concentrations that exceed method detection limit concentrations (organics) or reporting limit concentrations (inorganics), the source of contamination is investigated and eliminated before proceeding with sample analysis. Target analyte(s) in method blanks at concentrations no greater than one-half of the reporting limit concentrations (metals) may be requested on a client or project specific basis. Systematic contamination is documented for corrective action and resolved following the established corrective action procedures.

Laboratory Control Samples (LCS or Spiked Blanks). A laboratory control sample (spiked blank or commercially prepared performance evaluation sample) is analyzed along with field samples to demonstrate that method accuracy is within acceptable limits. These spike solutions may be from different sources than the sources of the solutions used for method calibration depending upon the method requirements. All target components are included in the spike mixture over a two year period. The performance limits are derived from published method specifications or from statistical data generated from the analysis of laboratory method performance samples. Spiked blanks are blank matrices (reagent water or clean sand) spiked with target parameters and analyzed using the same methods used for samples. Accuracy data is compared to laboratory derived limits to determine if the method is in control. Laboratory control samples (LCS) are commercially prepared spiked samples in an inert matrix. Performance criteria for recovery of spiked analytes are pre-established by the commercial entity preparing the sample. The sample is analyzed in the laboratory as an external reference.

Accuracy data is compared to the applicable performance limits. If the spike accuracy exceeds the performance limits, corrective action, as specified in the SOP for the method is performed and verified before continuing with a field sample analysis. In some cases, decisions are made to continue with sample analysis if performance limits are exceeded, provided the unacceptable result has no negative impact on the sample data.

Blanks and spikes are routinely evaluated before samples are analyzed. However, in situations where sample analysis is performed using an auto sampler, they may be evaluated after sample analysis has occurred. If the blanks and spikes do not meet criteria, sample analysis is repeated.

Proficiency Testing. Proficiency test samples (PTs) are single or double blind spikes, introduced to the laboratory to assess method performance. PTs may be introduced as double

blinds submitted by commercial clients, single or double blinds from regulatory agencies, or internal blinds submitted by the QA group.

A minimum of two single blind studies must be performed each year for every parameter in aqueous and solid matrices for each field of testing for which the laboratory maintains accreditation. Proficiency samples must be purchased as blinds from an A2LA accredited vendor. Data from these studies are provided to the laboratory by the vendor and reported to accrediting agencies. If unsatisfactory performance is noted, corrective action is performed to identify and eliminate any sources of error. A new single blind must be analyzed if required to demonstrate continuing proficiency.

PT samples performed for accrediting agencies or clients, which do not meet performance specifications, require a written summary that documents the corrective action investigation, findings, and corrective action implementation. A copy of this summary shall be submitted to the TNI Standard Primary Accrediting Authority, NJDEP Office of Quality Assurance for review.

Single or double blind proficiency test samples may be employed for self-evaluation purposes. Data from these analyses are compared to established performance limits. If the data does not meet performance specifications, the system is evaluated for sources of acute or systematic error. If required, corrective action is performed and verified before initiating or continuing sample analysis.

Trend Analysis for Control Parameters. The quality assurance staff is responsible for continuous analytical improvement through quality control data trend analysis. Accuracy data for spiked parameters in the spiked blank are statistically evaluated weekly for trends indicative of systematic problems. Data from LCS parameters and surrogates are pooled on a method, matrix, and instrument basis. This data is evaluated by comparison to existing control and warning limits. Trend analysis is performed automatically as follows:

- Any point outside the control limit
- Any three consecutive points between the warning and control limits
- Any eight consecutive points on the same side of the mean.
- Any six consecutive points increasing or decreasing

The results of the trend analysis are transmitted as .PDF files for supervisory evaluation prior to sample analysis. Trends that indicate the potential loss of statistical control are further evaluated to determine the impact on data quality and to determine if corrective action is necessary. If corrective action is indicated, the supervisor informs the analysts of the corrective actions to be performed. Return to control is demonstrated before analysis resumes.

12.3 ***Sample Control Parameters and Corrective Action***. The analysis of samples can be initiated following a successful demonstration that the method is operating within established controls. Additional controls are incorporated into the analysis of each sample to determine if the method is functioning within established specifications for each individual sample. Sample

QC data is evaluated and compared to established performance criteria. If the criteria are not achieved the method or the SOP specifies the corrective action required to continue sample analysis. In many cases, failure to meet QC criteria is a function of sample matrix and cannot be remedied. Each parameter is designed to provide quality feedback on a defined aspect of the sampling and analysis episode.

Duplicates. Duplicate sample analysis is used to measure analytical precision. This can also be equated to laboratory precision for homogenous samples. Precision criteria are method dependent. If precision criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Laboratory Spikes & Spiked Duplicates. Spikes and spiked duplicates are used to measure analytical precision and accuracy for the sample matrix selected. Precision and accuracy criteria are method dependent. If precision and accuracy criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before reporting sample data. All target components are included in the spike mixture over a two year period.

Serial Dilution (Metals). Serial dilutions of metals samples are analyzed to determine if analytical matrix effects may have impacted the reported data. If the value of the serially diluted samples does not agree with the undiluted value within a method-specified range, the sample matrix may be causing interferences, which may lead to either a high or low bias. If the serial dilution criterion is not achieved, it must be flagged to indicate possible bias from matrix effects.

Post Digestion Spikes. Digested samples are spiked and analyzed to determine if matrix interferences are biasing the results when the pre-digestion spike (matrix spike) recovery falls outside the control limits. It may also be used to determine potential interferences per client's specification. The sample is spiked at the concentration specified in the method SOP. No action is necessary if the post digestion spike is outside of the method criteria, unless a preparation problem is suspected with the spike, in which case the post digestion spike should be re-prepared and reanalyzed.

Surrogate Spikes (Organics). Surrogate spikes are organic compounds that are similar in behavior to the target analytes but unlikely to be found in nature. They are added to all quality control and field samples to measure method performance for each individual sample. Surrogate accuracy limits are derived from published method specifications or from the statistical evaluation of laboratory generated surrogate accuracy data. Accuracy data is compared to the applicable performance limits. If the surrogate accuracy exceeds performance limits, corrective action, as specified in the method or SOP is performed before sample data can be reported.

Internal Standards (Organic Methods). Internal standards are retention time and instrument response markers added to every sample to be used as references for quantitation. Their response is compared to reference standards and used to evaluate instrument sensitivity on a sample specific basis. Internal standard retention time is also compared to reference

standards to assure that target analytes are capable of being located by their individual relative retention time.

If internal standard response criteria are not achieved, corrective action or additional action may be required. The recommended action must be completed before sample data can be reported.

If the internal standard retention time criteria are not achieved corrective action or additional action may be required. This may include re-calibration and re-analysis. Additional action must be completed before sample data is reported.

Internal Standards (ICP and ICP/MS Metals). Internal standards are used on ICP instruments to compensate for variations in response caused by differences in sample matrices. Multiple internal standards are used for each sample on ICP/MS instruments to compensate for variations in response caused by differences in sample matrices. This adjustment is performed automatically during sample analysis. The internal standard response of replicated sample analysis is monitored to detect potential analytical problems. If analytical problems are suspected, then the field samples may be reanalyzed or reanalyzed upon dilution to minimize the interferences. A different internal standard may be employed for quantitation in situations where the field sample contains the element typically used as the internal standard.

12.4 ***Laboratory Derived Quality Control Criteria.*** Control criteria for in-house methods and client specific modifications that exceed the scope of published methodology are defined and documented prior to the use of the method. The Quality Assurance Director is responsible for identifying additional control criteria needs. Control parameters and criteria, based on best technical judgment are established using input provided by the operations staff. These control parameters and criteria are documented and incorporated into the method.

The laboratory-derived criteria are evaluated for technical soundness on spiked samples prior to the use of the method on field samples. The technical evaluation is documented and archived by the Quality Assurance Staff.

When sufficient data from the laboratory developed control parameter is accumulated, the data is statistically processed and the experimentally derived control limits are incorporated into the method.

12.5 ***Bench Review & Corrective Action***. The bench chemists are responsible for all QC parameters. Before proceeding with sample analysis, they are required to successfully meet all instrumental QC criteria. They have the authority to perform any necessary corrective action before proceeding with sample analysis. Their authority includes the responsibility for assuring that departures from documented policies and procedures do not occur.

The bench chemists are also responsible for all sample QC parameters. If the sample QC criteria are not achieved, they are authorized and required to perform the method specified corrective action before reporting sample data.

12.6 ***Data Qualifiers*****.** An alpha character coding system is employed for defining use limitations for reported data. These limitations are applied to analytical data by the analyst to clarify the usefulness of the reported data for data user. Common data qualifiers and their definitions are as follows:

Organics.

J: Indicates an estimated value. Applied to calculated concentrations for tentatively identified compounds and qualitatively identified compounds whose concentration is below the reporting limit, but above the MDL.

N: Indicates qualitative evidence of a tentatively identified compound whose identification is based on a mass spectral library search and is applied to all TIC results.

C: Applied to pesticide data that has been qualitatively confirmed by GC/MS.

B: Used for analytes detected in the sample and its associated method blank.

E: Applied to compounds whose concentration exceeds the upper limit of the calibration range.

Metals and Inorganics.

B: Applied if the reported concentration value was less than the reporting limit but greater than the MDL.

U: Applied if the reading is less than the MDL (or IDL if IDL reporting is being used).

E: Estimated concentration caused by the presence of interferences, normally applied when the serial dilution is out.

N: Spike sample recovery not within control limits.

*: Duplicate or matrix spike duplicate analysis not within control limits.

12.7 ***Data Package Review***. SGS Accutest Inc. employs at least two levels of data review, the final review must be performed by a manager, supervisor or designated reviewer, to assure that reported data has satisfied all quality control criteria and that client specifications and requirements have been met. Each production department has developed specific data review procedures, which must be completed before data is released to the client.

Analytical Review. The analyst conducts the primary review of all data. This review begins with a check of all instrument and method quality control and progresses through sample quality control, concluding with a check to assure that the client's requirements have been executed. Analyst checks focus on a review of qualitative determinations and checks of precision and accuracy data to verify that existing laboratory criteria have been achieved.

Checks at this level may include comparisons with project specific criteria if applicable. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.

Analysts who have met the qualification criteria for the method in use perform secondary, peer level data reviews. Analyst qualification requirements include a valid demonstration of capability and demonstrated understanding of the method SOP. Section supervisors may perform secondary review in-lieu of a peer review. Managers, Supervisors or designated reviewers evaluate 100% of the data produced by their department. It includes a check of all manual calculations; an accuracy check of manually transcribed data from bench sheets to the LIMS, a check of calibration and continuing calibration, all QC criteria and a comparison of the data package to client specified requirements. Also included are checks to assure the appropriate methodology was applied and that all anomalous information was properly flagged for communication in the case narrative. Supervisors have the authority to reject data and initiate re-analysis, corrective action, or reprocessing.

All laboratory data requiring manual entry into LIMS system is double-checked by the analysts performing initial data entry and the section supervisor. Verification of supervisory review is indicated on the raw data summary by the manager, supervisor, or designated reviewer's initials and date.

Electronic data that is manually edited at the bench by the primary analyst is automatically flagged by the instrument data system indicating an override by the analyst. All manual overrides must be verified and approved by a supervisor who initials and dates all manual changes.

Hard copies (or PDF's) of manually integrated chromatographic peaks are printed that clearly depict the manually drawn baseline. The hard copy (or PDF) is reviewed and approved by the section manager, supervisor or designated reviewer (initialed and dated) and included in the data package of all full tier reports or the archived batch records of commercial report packages.

Edits to electronic data that have already been committed to the LIMS database are controlled through the use of the Master Edit function in LIMS. Permission to access this program is limited to those approved by the upper levels of laboratory management and is controlled by the Information Technology staff. A GALP electronic audit record trail is maintained for all changes that are made and is automatically appended to the record.

The group manager performs a tertiary review on a spot check basis. This review includes an evaluation of QC data against acceptance criteria and a check of the data package contents to assure that all analytical requirements and specifications were executed.

Report Generation Review. The report generation group reviews all data and supporting information delivered by the laboratory for completeness and compliance with client specifications. Missing deliverables are identified and obtained from the laboratory. The

group also reviews the completed package to verify that the delivered product complies with all client specifications. Non-analytical defects are corrected before the package is sent to the client.

Project Management/Quality Control Review. Spot-check data package reviews are performed by the project management staff. Project management reviews focus on project specifications. If the project manager identifies defects in the product prior to release, he initiates immediate corrective action to rectify the situation.

The QA staff performs a post-delivery check of completed data packages to verify completeness and compliance with established quality control procedures. Approximately 10% of Full-Deliverables data packages are reviewed. A formal checklist is used to assess data report completeness and accuracy. Detected deficiencies are documented on the checklist and corrective actions initiated as necessary. Data review checklists are electronic documents, which are archived in the QA Directory of the network server.

The QA review focuses on all elements of the deliverable including the client's specifications and requirements, analytical quality control, sample custody documentation and sample identification. QA reviews at this step in the production process are geared towards systematic process defects, which require procedural changes to effect a corrective action. However, if defects are identified that have an adverse effect on data, the client is immediately informed following standard notification procedures. QA data review is not used in lieu of a peer level review or a supervisory review.

Data Reporting. Analytical data is released to clients following a secondary review by the manager, supervisor or designated reviewer. Data release at this stage of the process is limited to electronic information, which is released to clients through a secure, encrypted, password protected, Internet connection. Hard copy support data is compiled by the report generation group and assembled into the final report. The report is sent to the client following reviews by the report generation staff.

All data reports include specified information, which is required to identify the report and its contents. This information includes a title, name and address of the laboratory, a unique report number, total number of pages in the report, clients name and address, analytical method identification, arriving sample condition, sample and analysis dates, test results with units of measurement, authorized signature of data release, statement of applicability, report reproduction restrictions and TNI Standard requirements certification. Data reports for the Department of Defense ELAP also include the time of preparation and analysis.

12.8 ***Electronic Data Reduction.*** Raw data from sample analysis is entered into the laboratory information management system (LIMS) using automated processes or manual entry. Final data processing is performed by the LIMS using procedures developed by the Company.

All LIMS programs are tested and validated prior to use to assure that they consistently produce correct results. The Information Technology Staff performs software validation

testing. The testing procedures are documented in an SOP. Software programs are not approved for use until they have demonstrated that they are capable of performing the required calculations.

12.9 ***Representativeness***. Data representativeness is based on the premise that qualitative and quantitative information developed for field samples is characteristic of the sample that was collected by the client and analyzed in the laboratory. The laboratory objective for representativeness defines data as representative if the criteria for all quality parameters associated with the analysis of the sample are achieved.

12.10 ***Comparability***. Analytical data is defined as comparable when data from a sample set analyzed by the laboratory is representatively equivalent to other sample sets analyzed separately regardless of the analytical logistics. The laboratory will achieve 100% comparability for all sample data which meets the criteria for the quality parameters associated with its analysis using the method requested by the client.

13.0 CORRECTIVE ACTION SYSTEM

Requirement. The laboratory employs policies and procedures for correcting defective processes, systematic errors, and quality defects enabling the staff to systematically improve product quality. The system includes procedures for communicating items requiring corrective action to responsible individuals, corrective action tracking procedures, corrective action documentation, monitoring of effectiveness, and reports to management. The system is fully documented in a standard operating procedure. Individual corrective actions and responses are documented in a dedicated database.

13.1 ***Procedure***. Corrective action is the step that follows the identification of a process defect. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance. The formal system is maintained by the quality assurance department. Operations management is responsible for working within the system to resolve identified deficiencies.

Routine Corrective Action. Routine corrective action is defined as the procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical quality control parameters or analytical system specifications.

Bench analysts have full responsibility and authority for performing routine corrective action. The resolution of defects at this level does not require a procedural change or staff re-training. The analyst is free to continue work once corrective action is complete and the analytical system has been returned to control. Documentation of routine corrective actions is limited to logbook comments for the analysis being performed.

Process Changes. Corrective actions in this category require procedural modifications. They may be the result of systematic defects identified during audits, the investigation of client inquiries, failed proficiency tests, product defects identified during data review, or method updates. Resolution of defects of this magnitude requires formal identification of the defect, development and documentation of a corrective action plan, and staff training to communicate the procedural change.

Technical Corrective Action. Technical corrective action encompasses routine corrective action performed by bench analysts for out of control systems and corrective actions performed for data produced using out of control systems. Technical corrective action for routine situations is conducted using the procedures detailed above.

Non-routine corrective actions apply to situations where the bench analysts failed to perform routine corrective action before continuing analysis. Supervisors and Department Managers perform corrective action in these situations. Documentation of all non-routine corrective actions is performed using the corrective action system.

Sample re-analysis is conducted if sufficient sample and holding time remain to repeat the analysis using an in-control system. If insufficient sample or holding time remains, the data is

processed and qualifiers applied that describe the out of control situation. The occurrence is further documented in the case narrative and in the corrective action response. The corrective action must include provisions for retraining the analysts who failed to perform routine corrective action.

13.2 ***Documentation & Communication***. Routine corrective actions are documented as part of the analytical record. Notations are made in the comments section of the analytical chronicle or data sheet detailing the nonconformance and corrective action. Continuation of the analysis indicates that return to control was successful.

Corrective actions for process changes are documented, tracked and monitored for effectiveness. Supervisors or senior staff members may initiate corrective actions by generating a corrective action using the corrective action database application.

The corrective action database is an Access application. The initiator generates the corrective action investigation form, which is documented, tracked, distributed to responsible parties and archived through the application. The application assigns a tracking number, initiation data and due date to each action and copies the corrective action form to the database. E-mail message containing the form is automatically distributed to the responsible parties for resolution.

The responsible party identifies the root cause of the defect, initiates the immediate fix and develops and implements the procedural change. Existing documentation such as SOPs are edited to reflect the change. The affected staff is informed of the procedural change through a formal training session. The training is documented and copies are placed into individual training files. The corrective action form is completed by the responsible party and returned to the QA staff via e-mail using the database application.

Initial and completed corrective action forms are maintained in the corrective action database. This entire database is backed up and archived daily. The corrective action tracking form is maintained as an active report in the database.

Monitoring. The QA Staff monitors the implemented corrective action until it is evident that the action has been effective and the defect has been eliminated. The corrective action database is updated by QA to reflect closure of the corrective action. The QA staff assigns an error code to the corrective action for classification of the type of errors being committed. Additional monitoring of the corrective action is conducted during routine laboratory audits.

Additional monitoring of the corrective action is conducted by adding the corrective action to a verification list by the QA staff at closure. Verification is performed by the QA Staff to assure that the corrective action has remained in effect is scheduled for six (6) months from the initial closure date.

If QA determines that the corrective action response has not effectively remedied the deficiency, the process continues with a re-initiation of the corrective action. Corrective action

continues until the defect is eliminated. If another procedural change is required, it is treated as a new corrective action, which is documented and monitored using established procedures.

Client Notification. Defective processes, systematic errors, and quality defects, detected during routine audits may have negative impacts on data quality. In some cases, data that has been released to clients may be affected. If defective data has been released for use, SGS Accutest Inc. will notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

14.0 PROCEDURES FOR EXECUTING CLIENT SPECIFICATIONS

Requirement. Systems have been established for evaluating and processing client specifications for routine and non-routine analytical services. The systems enable the client services staff to identify, evaluate, and document the requested specifications to determine if adequate resources are available to perform the analysis. The system includes procedures for communicating the specifications to the laboratory staff for execution and procedures for verifying the specifications have been executed.

14.1 ***Client Specific Requirements***. The project manager is the primary contact for clients requesting laboratory services. Client specifications are communicated using several mechanisms. The primary sources of information are the client's quality assurance project plan (QAPjP) and the analytical services contract both of which detail the analytical, quality control and data reporting specifications for the project. In the absence of a QAPjP, projects specifications can also be communicated using contracts, letters of authorization, or letters of agreement, which may be limited to a brief discussion of the analytical requirements and the terms and conditions for the work. These documents may also include pricing information, liabilities and scope of work, in addition to the analytical requirements. QAPjPs include detailed analytical requirements and data quality objectives, which supersede those found in the referenced methods. This information is essential to successful project completion.

The client services staff provides additional assistance to clients who are unsure of the specifications they need to execute the sampling and analysis requirements of their project. They provide additional support to clients who require assistance in results interpretation as needed, provided they possess the expertise required to render an opinion.

The project manager is responsible for obtaining project documents, which specify the analytical requirements. Following project management review, copies are distributed to the QA Director and the appropriate departmental managers for review and comment. The original QAPjP is filed in a secure location.

14.2 ***Requirements for Non-Standard Analytical Specifications***. Client requirements that specify departures from documented policies, procedures, or standard specifications must be submitted to SGS Accutest Inc. in writing. These requirements are reviewed and approved by the technical staff before the project is accepted. Once accepted, the non-standard requirements become analytical specifications, which follow the routine procedure for communicating client specifications. Departures from documented policies, procedures, or standard specifications that do not follow this procedure are not permitted.

14.3 ***Evaluation of Resources.*** A resource evaluation is completed prior to accepting projects submitted by clients. The evaluation is initiated by the client services staff who prepares a brief synopsis that includes the logistical requirements of the project. Logistical specifications for new projects are summarized in writing for evaluation by the affected departments. The specifications are evaluated by the department manager from a scheduling and hardware

resources perspective. The project is not accepted unless the department managers have the necessary resources to execute the project according to client specifications.

14.4 ***Documentation***. New projects are initiated using LIMS or a project set up form, which is completed prior to the start of the project. This form details all of the information needed to correctly enter the specifications for each client sample into the laboratory information management system (LIMS). The form includes data reporting requirements, billing information, data turnaround times, QA level, state of origin, and comments for detailing project specific requirements. The project manager is responsible for obtaining this information from the client and completing the form prior to sample arrival and login.

Sample receipt triggers project creation and the login process. The information on the set-up form is entered into the LIMS immediately prior to logging in the first sample. The set up form may be accompanied by a quotation, which details the analytical product codes and sample matrices. These details are also entered into the LIMS during login.

Special information is distributed to the laboratory supervisors and login department in electronic or hardcopy format upon project setup. All, project specific information is retained by the project manager in a secure file. The project manager maintains a personal telephone log, which details conversations with the client regarding the project.

Department managers prepare summary sheets that detail client specific analytical requirements for each test. Bench analysts use these sheets to obtain information regarding client specific analytical requirements before analyzing samples. A program code is established for each client that links the client specifications to a client project. This code is attached to a project by the project manager at login and listed on the work list for each work group conducting analysis for clients with standing requirements.

14.5 ***Communication***. A pre-project meeting is held between client services and the operations managers to discuss the specifications described in the QAPjP, contract and/or related documents. Project logistics are discussed and finalized and procedures are developed to assure proper execution of the client's analytical specifications and requirements. Questions, raised in the review meeting, are discussed with the client for resolution. Exceptions to any requirements, if accepted by the client, are documented and incorporated into the QAPjP or project documentation records.

Non-standard specifications for individual clients are documented in the LIMS at the client account level or program level. Simple specifications are documented as comments for each project. Once entered into the LIMS, these specifications become memorialized for all projects related to the client account. Complex specifications are assigned program codes that link the specification to detailed analytical specifications.

Upon sample arrival, these specifications are accessed through a terminal or printed as a hard copy and stored in a binder for individuals who require access to the specification. Specifications that are not entered into the LIMS are prohibited unless documented in an

interdepartmental memo, which clearly identifies the project, client and effective duration of the specification.

14.6 ***Operational Execution***. A work schedule is prepared for each analytical department on a daily basis. Analytical specifications or program codes from recently arrived samples have now been entered into the LIMS database. The database is sorted by analytical due date and holding time, into product specific groups. Samples are scheduled for analysis by due date and holding time. The completed schedule, which is now defined as a work list, is printed. The list contains the client requested product codes, program codes and specifications required for the selected sample(s). Special requirements are communicated to the analyst using the comments section or relayed through verbal instructions provided by the supervisor. The bench analyst assumes full responsibility for performing the analysis according to the specifications printed on the work sheet.

14.7 ***Verification***. Prior to the release of data to the client, the report generation staff review the report and compare the completed product to the client specifications documentation to assure that all requirements have been met. Project managers perform a spot check of projects with unique requirements to assure that the work was executed according to specifications.

15.0 CLIENT COMPLAINT RESOLUTION PROCEDURE

Requirement. The laboratory follows a formal system for managing and reconciling client complaints. The system includes procedures for documenting the complaint and communicating it to the appropriate department for resolution. The system also includes a quality assurance evaluation to determine if the complaint is related to systematic defects requiring corrective action and process changes.

15.1 ***Procedure***. Client complaints are communicated to client services representatives, quality assurance staff, or senior management staff for resolution. The individual receiving the complaint retains the responsibility for documentation and communicating the nature of the complaint to the responsible department(s) for resolution. The responsible party addresses the complaint. The resolution is communicated to quality assurance (QA) and the originator for communication to the client. QA reviews the complaint and resolution to determine if systematic defects exist. If systematic defects are present, QA initiates a corrective action for the responsible party who develops and implements a response that eliminates the defect. If systematic defects are not present and the resolution is satisfactory, the QA Staff will close the complaint/inquiry with a no further action is necessary tag.

15.2 ***Documentation***. Client's complaints are documented by the individual receiving the complaint using the Data Query and Corrective Action Inquiry Process. This process generates an E-Mail message that contains detailed information essential to the complaint resolution. A record of the telephone conversation is maintained by client services. The message is distributed to the QA staff and the party bearing responsibility for resolution by E-Mail. The complaint resolution is documented on the message by the responsible party and returned to the originator. A copy is sent to QA for review and database archiving.

15.3 ***Corrective Action***. Responses to data queries are required from the responsible party. At a minimum, the response addresses the query and provides an explanation to the complaint. Formal corrective action may focus on the single issue expressed in the complaint. Corrective action may include reprocessing of data, editing of the initial report, and re-issue to the client. If the QA review indicates a systematic error, process modification is required. The defective process at the root of the complaint is changed. SOPs are either created or modified to reflect the change. The party responsible for the process implements process changes.

15.4 ***QA Monitoring***. Process changes, implemented to resolve systematic defects, are monitored for effectiveness by QA. If monitoring indicates that the process change has not resolved the defect, QA works with the department management to develop and implement an effective process. If monitoring indicates that the defect has been resolved, monitoring is slowly discontinued and the corrective action is closed. Continued monitoring is incorporated as an element of the annual system audit.

16.0 CONTROL OF NONCONFORMING PRODUCT

Requirement: Policies and procedures have been developed and implemented that describe the procedures employed by the laboratory when any aspect of sample analysis or data reporting do not conform to established procedures or client specifications. These procedures include steps to ensure that process defects are corrected and affected work is evaluated to assess its impact to the client.

Procedure. Nonconforming product is identified through routine internal review and audit practices or through client inquiry. The individuals who identify the nonconformance or receiving a nonconformance inquiry immediately inform the Laboratory Director and the Quality Assurance Director. The Laboratory Director initiates an evaluation of the nonconformance through the Quality Assurance Department and takes full responsibility for managing the process and identifying the course of action to take, initiating corrective action and mitigating the impact of the nonconformance to the client. Reference SOP EQA 065 Control of Non-Conforming Product and EQA 038 Complaints & Data Inquiry for specific procedures on handling non-conformances and Data Inquires.

16.1 ***Corrective Action.*** The outcome of the evaluation dictates the course of action. This includes client notification when the quality of data reported has been impacted and may also include corrective action if applicable. Immediate corrective action is performed using the procedures specified in SGS Accutest Inc. SOP EQA011. However, additional action may be required including cessation of analysis and withholding and or recalling data reports. If the evaluation indicates that nonconforming data may have been issued to clients, the client is immediately notified and data may be recalled following the procedures specified in SOP EQA011. If work has been stopped because of a nonconformance, the Laboratory Director is the only individual authorized to direct a resumption of analysis.

Non-conformances caused by systematic process defects require retraining of the personnel involved as an element of the corrective action solution.

17.0 CONFIDENTIALITY PROTECTION PROCEDURES

Requirements: Policies and procedures have been developed to protect client data from release to unauthorized parties or accidental release of database information through accidental electronic transmission or illegal intrusion. These policies have been communicated to clients and staff. Electronic systems are regularly evaluated for effectiveness.

17.1 ***Client Anonymity***. Information related to the Company's clients is granted to employees on a "need to know" basis. An individual's position within the organization defines his "need to know". Individuals with "need to know" status are given password access to systems that contain client identity information and access to documents and document storage areas containing client reports and information. Access to client information by individuals outside of the Company is limited to the client and individuals authorized by the client.

Individuals outside of the Company may obtain client information through subpoena issued by a court of valid jurisdiction. Clients are informed when subpoenas are received ordering the release of their information.

Client information may be released directly to regulatory agencies without receiving client authorization under specified circumstances. These circumstances require that the regulatory agency have statutory authority under the regulations for laboratory certification and that SGS Accutest Inc.'s operations fall under the purview of the regulation. In these situations, SGS Accutest Inc. will inform the client of the regulatory agencies request for information pertaining to his data and proceed with the delivery of the information to the regulatory agency.

17.2 ***Documents***. Access to client documents is restricted to employees in need to know positions. Copies of all client reports are stored in secure electronic archives with restricted access. Reports and report copies are distributed to individuals who have been authorized by the client to receive them. Data reports or data are not released to third parties without verbally expressed or written permission from the client.

17.3 ***Electronic Data***.

Database Intrusion. Direct database entry is authorized for employees of SGS Accutest Inc. only on a need to know basis. Entry to the database is restricted through a user specific multiple password entry system. Direct access to the database outside the facility is possible through secured channels set up by SGS Accutest Inc. A unique password is required for access to the local area network. A second unique password is required to gain access to the database. The staff receives read or write level authorization on a hierarchical privilege basis.

Internet Access. Access to client information is through an HTTP Web application only. It does not contain a mechanism that allows direct access to the database. Clients can gain access to their data only using a series of SGS Accutest Inc. assigned client and user specific

passwords. The viewable data, which is encrypted during transmission, consists of an extraction of database information only.

Client Accessibility. Accessibility to client data delivered via electronic means follows strict protocols to insure confidentiality. Clients accessing electronic data are assigned a company account. The account profile, which is established by the MIS staff, grants explicit access to specific information pertaining to the client's project activity. Passwords are assigned on an individual basis within a client account. These accounts can be activated or deactivated by the MIS staff only.

17.4 ***Information Requests***. Client specific data or information is not released to third parties without verbally expressed or written permission from the client. Written permission is required from third parties, who contact the Company directly for the release of information. Verbal requests will be honored only if they are received directly from the client. These requests must be documented in a record of communication maintained by the authorized recipient.

17.5 ***Transfer of Records***. Archived data, which has previously been reported and transmitted to clients, is the exclusive property of SGS Accutest Inc. In the event of a cessation of business activities due to business failure or sale, The Company's legal staff will be directed to arrange for the final disposition of archived data.

The final disposition of archived data will be accomplished using the approach detailed in the following sequence:

1. All data will be transferred to the new owners for the duration of the required archive period as a condition of sale.

2. If the new owners will not accept the data or the business has failed, letters will be sent to clients listed on the most recent active account roster offering them the option to obtain specific reports (identified by SGS Accutest Inc. Job Number) at their own expense.

3. A letter will be sent to the TNI Standard accrediting authority with organizational jurisdiction over the company offering them the option to obtain all unclaimed reports at their own expense.

4. All remaining archived data will be recycled using the most expedient means possible.

18.0 QUALITY AUDITS AND SYSTEM REVIEWS

Requirement: The quality assurance group conducts regularly scheduled audits of the laboratory to assess compliance with quality system requirements, technical requirements of applied methodology, and adherence to documentation procedures. The information gathered during these audits is used to provide feedback to senior management and perform corrective action where needed for quality improvement purposes.

18.1 ***Quality System Reviews***. Quality system reviews are performed annually by the Quality Assurance Director for the Company President. In this review, the laboratory is evaluated for compliance with the laboratory Quality Systems Manual (QSM) and the quality system standards of the National Environmental Laboratory Accreditation Conference. Findings, which indicate non-compliance or deviation from the QSM, are flagged for corrective action. Corrective actions require either a return to compliance or a plan change to reflect an improved quality process. The Quality Assurance Director is responsible for making and documenting changes to the QSM. These changes are reviewed by the Company President and The Laboratory Director prior to the approval of the revised system.

18.2 ***Quality System Audits.*** Quality system audits are conducted to evaluate the effectiveness and laboratory compliance with individual quality system elements. These audits are conducted on an established schedule. Audit findings are documented and communicated to the management staff and entered into the corrective action system for resolution. If necessary, retraining is conducted to assure complete understanding of the system requirements.

18.3 ***Test Method Assessments.*** Test Method Assessments are performed throughout the year following an established schedule. Selected analytical procedures are evaluated for compliance with standard operating procedures (SOPs) and method requirements. If non-conformances exist, the published method serves as the standard for compliance. SOPs are edited for compliance if the document does not reflect method requirements. Analysts are trained to the new requirements and the process is monitored by quality assurance. Analysts are retrained in method procedures if an evaluation of bench practices indicates non-compliance with SOP requirements.

18.4 ***Documentation Audits***. Documentation audits are conducted during routine internal audits. The audit includes a check of measurement processes that require manual documentation. It also includes checks of data archiving systems and a search to find and remove any inactive versions of SOPs that may still be present in the laboratory and being accessed by the analysts. Non-conformances are corrected on the spot. Procedural modifications are implemented if the evaluation indicates a systematic defect.

18.5 ***Corrective Action Monitoring***. Defects or non-conformances that are identified during client or internal audits are documented in the corrective action systems and corrected through process modifications and/or retraining. Once a corrective action has been designed and implemented, it is monitored for compliance on a regular basis by the QA staff. Spot

corrections are performed if the staff is not following the new procedure. Monitoring of the corrective action continues until satisfactory implementation has been verified.

18.6 ***Preventive Action.*** Laboratory systems or processes, which may be faulty and pose the potential for non-conformances, errors, confusing reports or difficulties establishing traceability may be identified during internal audits. These items are highlighted for systematic change using the corrective action system and managed to resolution using the procedures for corrective action identified in EQA041.

18.7 ***Client Notification.*** Defective processes, systematic errors, and quality defects, detected during routine audits may have negative impacts on data quality. In some cases, data that has been released to clients may be affected. If defective data has been released for use, SGS Accutest Inc. will immediately notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

18.8 ***Management Reports.*** Formal reports of all audit and proficiency testing activity are prepared for the management staff and presented as they occur. Additional reports may be presented orally at regularly scheduled staff meetings

Management reports may also address the following topics:

- Status and results of internal and external audits,
- Status and results of internal and external proficiency testing,
- Identification of quality control problems in the laboratory,
- Discussion of corrective action program issues,
- Status of external certifications and approvals,
- Status of staff training and qualifications,
- Discussion of new quality system initiatives.
- Recommendations for further action on listed items are included in the report.

19.0 HEALTH AND SAFETY

Requirement. The company operates a formal health and safety program that complies with the requirements of the Occupational Health and Safety Administration. The program consists of key policies and practices that are essential to safe laboratory operation. All employees are required to receive training on the program elements. Job specific training is conducted to assure safe practices for specific tasks. All employees are required to participate in the program, receive initial and annual training, and comply with the program requirements. All plan and program requirements are detailed in the Health and Safety Program Manual.

19.1 **Policy.** SGS Accutest Inc. Laboratories will provide a safe and healthy working environment for its employees and clients while protecting the public and preserving the Company's assets and property. The company will comply with applicable government regulations pertaining to safety and health in the laboratory and the workplace.

The objective of the SGS Accutest Inc. Health and Safety Program is to promote safe work practices that minimize the occurrence of injuries and illness to the staff through proper health and safety training, correct laboratory technique application and the use of engineering controls.

19.2 **Responsibilities.** The Health and Safety Program assists managers, supervisors and non-supervisory employees in control of hazards and risks to minimize the potential for employee and client injuries, damage to client's property and damage or destruction to SGS Accutest Inc.'s facility.

The Director, Health and Safety (EHS Director) is responsible for implementing the Program's elements and updating its contents as necessary. He/she also conducts periodic audits to monitor compliance and assess the program's effectiveness. The EHS Director is also responsible for creating and administering safety training for all new and existing employees.

The employee is responsible for following all safety rules established for their protection, the protection of others and the proper use of protective devices provided by the Company. The employee is also expected to comply with the requirements of the program at all times. Department Managers and Supervisors are responsible for ensuring the requirements of the Safety Program are practiced daily. The Company President retains the ultimate responsibility for the program design and implementation.

19.3 **Program Elements.** The SGS Accutest Inc. Health and Safety Program consists of key program elements that complement the company's health and safety objective. These elements form the essence of the health and safety policy and assure that the objectives of the program are achieved.

Safety Education and Training and Communication. Training is conducted to increase the staff's awareness of laboratory hazards and their knowledge of the safety practices and

procedures required to protect them from those hazards. It is also used to communicate general safety procedures required for safe operation in a chemical laboratory.

Initial health and safety training for new employees is conducted during orientation. The training focuses on the SGS Accutest Inc. Safety and Health Program and includes specific training for the hazards that may be associated with the employees duties. Training is also conducted for all program elements focusing on general, acceptable, laboratory safety procedures. Targeted training is conducted to address hazards or safety procedures that are specific to individual employee's work assignments. All training activities are documented and archived in individual training folders. A health and safety training inventory is maintained in the training database.

Safety Committee. The safety committee provides the employee with an opportunity to express their views and concerns on safety issues in a forum where those concerns will be addressed. This committee meets monthly to assure that the interests of the company and the well being of the employee are protected. They also serve as a catalyst for elevating the level of safety awareness among their peers.

Hazard Identification and Communication. The hazard communication program enables employees to readily identify laboratory hazards and the procedures to protect themselves from those hazards. This program complies with OSHA's Hazard Communication Standard, Title 29 Code of Federal Regulations 1910.1200 that requires the company to adopt and adhere to the following key elements:

- Safety Data Sheets (SDS) must be available to any employee wishing to view them,
- The Company must maintain a Hazardous Chemicals Inventory (by location), which is updated on an annual basis,
- Containers are properly labeled,
- All employees must be provided with annual Hazard Communication and Right to Know training,

The hazard communication program also complies with the requirements of the New Jersey Worker and Community Right to Know Law, NJAC 8:95.

Identification of Workplace Hazards. The workplace hazard identification procedures have been designed to assure that hazards that have the potential to cause personnel injury or destruction of property are identified, managed and/or systematically eliminated from the operation. This system eliminates hazards, limits the potential for injury and increases the overall safety of the work environment.

Employee Exposure Assessment. Employee exposure assessment is performed to identify and evaluate potential exposure hazards associated with the employees work station. The

exposure assessment data is used to determine if changes or modifications to the work station are needed to limit exposure to laboratory conditions that could negatively affect an employee's health or disclosed existing medical conditions.

Bloodborne Pathogens. SGS Accutest Inc. has implemented awareness training on the OSHA Bloodborne Pathogen Standard, 29CFR1910.1030 to reduce occupational exposure to Hepatitis B Virus (HBV), Human Immunodeficiency Virus (HIV) and other bloodborne pathogens that employees may encounter in their workplace.

Respiratory Protection Plan. The respiratory protection plan assures that SGS Accutest Inc. employees are protected from exposure to respiratory hazards. This program is used in situations where engineering controls and/or safe work practices do not completely control the identified hazards. In these situations, respirators and other protective equipment are used. Supplemental respiratory protection procedures are applied to specified maintenance personnel, employees who handle hazardous wastes in the hazardous waste storage area, and any employee that voluntarily elects to wear a respirator.

Chemical Hygiene Plan. The Chemical Hygiene Plan complies with the requirements of the Occupational Safety and Health Administration's Occupational Exposure to Hazardous Chemicals in the Laboratory Standard, 29 CFR 1910.1450. This plan establishes procedures, identifies safety equipment, personal protective equipment, and work practices that protect employees from the hazardous chemicals in the laboratory when properly used and applied.

Chemical Spill Response Plan. The chemical spill response plan has been designed to minimize the risks from a chemical spill or accidental chemical release in the laboratory. Risk minimization is accomplished through a planned response that follows a defined procedure. The designated staff have been trained to execute spill response procedures according to the specifications of the plan, which identifies the appropriate action to be taken based on the size of the spill.

Emergency Action & Evacuation Plan. The Emergency Action and Evacuation Plan details the procedures used to protect and safeguard SGS Accutest Inc.'s employees and property during emergencies. Emergencies are defined as fires or explosions, gas leaks, building collapse, hazardous material spills, emergencies that immediately threaten life and health, bomb threats and natural disasters such as floods, hurricanes or tornadoes, terrorism or terrorist actions. The plan identifies and assigns responsibility for executing specific roles in situations requiring emergency action. It also describes the building security actions coinciding with the "Alert Condition", designated by the Department of Homeland Security.

Lockout/Tagout Plan. Lockout/tagout procedures have been established to assure that laboratory employees and outside contractors take steps to render equipment inoperable and/or safe before conducting maintenance activities. The plan details the procedures for conducting maintenance on equipment that has the potential to unexpectedly energize, start up, or release energy or can be operated unexpectedly or accidentally resulting in serious injury

to employees. The plan ensures that employees performing maintenance render the equipment safe through lock out or tag out procedures.

Personal Protection Policy. Policies have been implemented which detail the personal protection requirements for employees. The policy includes specifications regarding engineering controls, personal protective equipment (PPE), hazardous waste, chemical exposures, working with chemicals and safe work practices. Safety requirements specific to processes or equipment are reviewed with the department supervisor or the EHS Director before beginning operations.

Visitor and Contractor Safety Program. A safety brochure is given to all visitors and contractors who visit or conduct business at the facility. The brochure is designed to inform anyone who is not an employee of SGS Accutest Inc. of the laboratory safety procedures. The brochure directs them to follow all safety programs and plans while on SGS Accutest Inc. property. This program also outlines procedures for visitors and contractors in the event of an emergency. Visitors are required to acknowledge receipt and understanding of the SGS Accutest Inc. policy.

Appendix I

Glossary of Terms

GLOSSARY OF TERMS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity.

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same TNI Standard-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group.

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

Calibration Curve: the graphical relationship between the known values, such as concentrations of a series of calibration standards and their instrument response.

Calibration Method: a defined technical procedure for performing a calibration.

Calibration Range: the range of concentrations between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.

Calibration Standard: a substance or reference material used to calibrate an instrument.

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation, which is issued by a certifying body.

Chain of Custody (COC): an unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples.

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to second column confirmation, alternate wavelength, derivatization, mass spectral, interpretation, alternative detectors or, additional cleanup procedures.

Continuing Calibration Verification (CCV): the verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Corrective Action (CA): the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.

Demonstration of Capability (DOC): a procedure to establish the ability of the analyst to generate acceptable accuracy.

Documentation of Understanding (DOU): certifies that the analyst or technician has read and understood the procedures detailed in the Standard Operating Procedure (SOP) and will follow the SOP as written.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Duplicate Analyses (DUP): the analyses or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Field of Testing: TNI Standard's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an

up-dated/improved method are required submit to only that portion of the accreditation process not previously addressed (see TNI Standard, section 1.9ff).

Laboratory Control Sample-LCS (such as laboratory fortified blank, spiked blank, or QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Limit of Detection (LOD): an estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific. DoD clarification is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

Limit of Quantitation (LOQ): the minimum levels, concentrations, or quantities of a target analyte that can be reported with a specified degree of confidence. DoD clarification is the lowest concentration that produces a quantitative result within specified limits of precision and bias. The LOQ shall be at or above the concentration of the lowest initial calibration standard.

Matrix: the component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source. Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake. Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Biota: animal or plant tissue, consisting of entire organisms, homogenates, and/or organ or structure specific subsamples.

Matrix Spike-MS (spiked sample or fortified sample): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target

analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate -MSD (spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank (MB): a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit (MDL): the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program.

NELAP Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference.

Performance Audit: the routine comparison of independently obtained *qualitative and quantitative* measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control (QC): the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Manual: a document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Reporting Limits (RL): the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

Reagent Blank (method reagent blank or method blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

Sample Duplicate (SD): two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: the document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of TNI Standard and meets the approval requirements of TNI Standard procedures and policies.

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

Validation: the process of substantiating specified performance criteria.

Work Cell: A defined group of analysts that together perform the method analysis. Members of the group and their specific functions within the work cell must be fully documented. A "work cell" is considered to be all those individuals who see a sample through the complete process of preparation, extraction, or analysis. The entire process is completed by a group of capable individuals; each member of the work cell demonstrates capability for each individual step in the method sequence.

Appendix II

Standard Operating Procedures Directory

SGS Accutest Inc. Laboratories
Standard Operating Procedures

Section	Standard Operating Procedure Title	Number
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General Chem	Salinity - SM182520B	EGN158
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Quality Assurance	Standards Traceability Documentation Procedure	EQA014
Quality Assurance	Template for Standard Operating Procedures	EQA016
Quality Assurance	Management/Reporting Of Proficiency Test (PT) Samples	EQA017
Quality Assurance	Creating/Distributing/Tracking Internal Chains Of Custody	EQA018
Quality Assurance	Creating New Accounts	EQA019
Quality Assurance	Creating New Projects	EQA020
Quality Assurance	Creating Product Codes	EQA021
Quality Assurance	Procedures For The Purchase Of Laboratory Supplies	EQA023
Quality Assurance	Control & Archiving Of Laboratory Documents	EQA025
Quality Assurance	Confidentiality Protection Procedures	EQA027
Quality Assurance	Quality System Review	EQA028
Quality Assurance	Contract Review	EQA029
Quality Assurance	Procedure for the Development and Application of MDLs and RLs	EQA030
Quality Assurance	Subcontracting Procedures	EQA031
Quality Assurance	Signature Authority	EQA032
Quality Assurance	Review of Inorganic Data	EQA034
Quality Assurance	Review of Organic Data	EQA035
Quality Assurance	Documentation of Equipment Maintenance	EQA036
Quality Assurance	Procedures for Accepting Departures from Laboratory Specifications	EQA037
Quality Assurance	Client Complaints Resolution Procedure	EQA038
Quality Assurance	Employee Technical Ethics Responsibilities	EQA039
Quality Assurance	Internal Audit Procedure	EQA041
Quality Assurance	Procedure for Obtaining Representative Sample Aliquots	EQA042
Quality Assurance	Procedure for Development &use of In-House Q C Criteria	EQA043
Quality Assurance	Manual Integration of Chromatographic Peaks	EQA044
Quality Assurance	Deionized Water Quality Control	EQA046
Quality Assurance	Management and Control of Change	EQA047
Quality Assurance	Laboratory Equipment Purchase and Removal From Service	EQA048
Quality Assurance	Calibration of Microliter Syringes	EQA049
Quality Assurance	Autosampler Vial Labeling Procedure (formally EOP041-01)	EQA050
Quality Assurance	pH for Volatile Samples	EQA051
Quality Assurance	Quality Control Review of Data Packages	EQA054
Quality Assurance	Procedures for Determining Method Comparability	EQA055
Quality Assurance	Refrigerator Storage Holding Blank Procedure	EQA056

SGS Accutest Inc. Laboratories
Standard Operating Procedures

Section	Standard Operating Procedure Title	Number
Quality Assurance	Data Integrity Training Procedure	EQA057
Quality Assurance	Data Integrity Monitoring Procedure	EQA058
Quality Assurance	Procedure for Conducting Data Integrity Investigations	EQA059
Quality Assurance	Quality Control Requirements for Organics by GC/GCMS using EPA 500 & 600 Series, SW846 8000 Series and CLP Methodologies	EQA060
Quality Assurance	Procedure for the Confidential Reporting of Data Integrity Issues	EQA061
Quality Assurance	Calibration of Volumetric Dispensers for Volume Critical Processes	EQA062
Quality Assurance	Calibration of Volumetric Dispensers / Non-Critical Volumes Processes	EQA063
Quality Assurance	Glassware Preparation for use in VOA analysis	EQA064
Quality Assurance	Control of Non-Conforming Product	EQA065
Quality Assurance	Client Notification of Key Personnel Changes	EQA066
Quality Assurance	Review of Inorganic Notebooks	EQA067
Quality Assurance	Disposal of Spent Semi-Volatile Organic Extracts	EQA068
Quality Assurance	Compressed Gas Management	EQA069
Quality Assurance	Procedure for Tracking Quality Control Non-Conformances	EQA070
Quality Assurance	Procedure for the Development and Application of Experimental Method Detection Limits, limits of detection, and limits of quantitation for inorganic applications	EQA071
Quality Assurance	Procedure for Particle Size Reduction (Crushing)/Homogenization of solid matrices	EQA072
Quality Assurance	Compositing Samples	EQA073
Report Generation	Report Generation–Data Package	ERG002
Sample Mgmt.	Sample Storage	ESM001
Sample Mgmt.	Chain Of Custody And Log In Procedure	ESM002
Sample Mgmt.	Temperature Maintenance Of Shipping Coolers	ESM004
Sample Mgmt.	Cooler Packaging And Shipping Procedure	ESM008
Sample Mgmt.	Procedures for Sample Couriers	ESM011
Sample Mgmt.	Summa Canister Shipment & Retrieval: NJDEP 03-X-35135	ESM012

Appendix III

Analytical Capabilities

Method Capabilities by NELAP Accredited Fields of Testing

Analytes	Method Number	Program	Chemistry Field
Alkalinity	SM 2320 B-11	Drinking Water	Inorganic Analysis
Ammonia	SM 4500-NH_3 H-11	Drinking Water	Inorganic Analysis
Chloride, Fluoride, Sulfate	EPA 300.0	Drinking Water	Inorganic Analysis
Chlorine, Total Residual	SM 4500-CL F-11	Drinking Water	Inorganic Analysis
Color, Apparent	SM 2120 B-11	Drinking Water	Inorganic Analysis
Conductivity	SM 2510 B-11	Drinking Water	Inorganic Analysis
Cyanide	EPA 335.4	Drinking Water	Inorganic Analysis
Foaming Agents (MBAS)	SM 5540 C-11	Drinking Water	Inorganic Analysis
Nitrate	EPA 353.2	Drinking Water	Inorganic Analysis
Nitrite	SM 4500-NO_2 B	Drinking Water	Inorganic Analysis
Odor	SM 2150 B-11	Drinking Water	Inorganic Analysis
Organic Carbon, Total (TOC)	SM 5310 B-11	Drinking Water	Inorganic Analysis
Dissolved Organic Carbon (DOC)	5310 B, C, D	Drinking Water	Inorganic Analysis
Orthophosphate	SM 4500-P E-11	Drinking Water	Inorganic Analysis
Perchlorate	EPA 314.0	Drinking Water	Inorganic Analysis
pH, Hydrogen Ion	SM 4500-H^+ B-11	Drinking Water	Inorganic Analysis
Silica, Dissolved	SM 4500-Si D(18^{th}/19^{th} ed)	Drinking Water	Inorganic Analysis
Temperature	SM 2550 B	Drinking Water	Inorganic Analysis
Total Dissolved Solids	SM 2540 C-11	Drinking Water	Inorganic Analysis
Total Organic Halides (TOX)	SM 5320 B	Drinking Water	Inorganic Analysis
Turbidity	EPA 180.1	Drinking Water	Inorganic Analysis
Hardness, Calcium	EPA 200.7	Drinking Water	Metals Analysis
Hardness, Total	EPA 200.7	Drinking Water	Metals Analysis
Hardness, Total	SM 2340 C-11	Drinking Water	Metals Analysis
Mercury	EPA 245.1	Drinking Water	Metals Analysis
Metals	EPA 200.7	Drinking Water	Metals Analysis
Metals	EPA 200.8	Drinking Water	Metals Analysis
DBCP, EDB & TCP	EPA 504.1	Drinking Water	Organics Analysis
Volatile Organics	EPA 524.2	Drinking Water	Organics Analysis
Total Coliform/E. Coli	SM 9223 B	Drinking Water	Microbiology
Heterotrophic Bacteria	SM 9215 B	Drinking Water	Microbiology

Method Capabilities by NELAP Accredited Fields of Testing

Analytes	Method Number	Program	Chemistry Field
Acidity as $CaCO_3$	SM 2310 B-11	Wastewater	Inorganic Analysis
Alkalinity as $CaCO_3$	SM 2320 B-11	Wastewater	Inorganic Analysis
Ammonia	SM20 4500-NH_3-B+H-11	Wastewater	Inorganic Analysis
Biochemical Oxygen Demand	SM 5210 B-11	Wastewater	Inorganic Analysis
Bromide, Chloride, Fluoride, Sulfate	EPA 300.0	Wastewater	Inorganic Analysis
Carbonaceous BOD (CBOD)	SM 5210 B-11	Wastewater	Inorganic Analysis
Chemical Oxygen Demand (COD)	SM 5220 B or C-11	Wastewater	Inorganic Analysis
Chloride	SM 4500-Cl C-11	Wastewater	Inorganic Analysis
Chlorine, Total Residual	SM 4500-Cl F-11	Wastewater	Inorganic Analysis
Chromium (VI)	SM 3500-Cr B-11	Wastewater	Inorganic Analysis
Chromium (VI)	EPA 218.7	Wastewater	Inorganic Analysis
Color, Apparent	SM 2120 B-11	Wastewater	Inorganic Analysis
Cyanide (Sample Preparation)	SM 4500-CN C+E-11	Wastewater	Inorganic Analysis
Cyanide (Analytical Finish)	EPA 335.4	Wastewater	Inorganic Analysis
Cyanide Amenable to Chlorine	SM 4500-CN-B or C-11+G-11	Wastewater	Inorganic Analysis
Hardness, Total as $CaCO_3$	SM 2340C-11	Wastewater	Inorganic Analysis
Iron, Ferrous	SM 3500-Fe B-11	Wastewater	Inorganic Analysis
Kjeldahl Nitrogen, Total	EPA 351.2	Wastewater	Inorganic Analysis
Nitrate/Nitrite	EPA 353.2	Wastewater	Inorganic Analysis
Nitrite	SM 4500-NO_2 B-11	Wastewater	Inorganic Analysis
Oil & Grease, HEM-LL	EPA 1664A	Wastewater	Inorganic Analysis
Oil & Grease, SGT-HEM, Non-Polar	EPA 1664A	Wastewater	Inorganic Analysis
Organic Nitrogen	SM 4500-N B+G EPA 351.2	Wastewater	Inorganic Analysis
Orthophosphate	EPA 365.3	Wastewater	Inorganic Analysis
Oxygen, Dissolved, Winkler	SM 4500-O C-11	Wastewater	Inorganic Analysis
Oxygen, Dissolved	SM 4500-O G-11	Wastewater	Inorganic Analysis
pH Hydrogen Ion	SM 4500-H B-11	Wastewater	Inorganic Analysis
pH Aqueous Electrometric	SW-846 9040C	Wastewater	Inorganic Analysis
Temperature Thermometric	SM 2550 B-00	Wastewater	Inorganic Analysis
Phenols	EPA 420.4	Wastewater	Inorganic Analysis
Phenols (Analytical Finish)	SW846 9066	Wastewater	Inorganic Analysis
Phosphorus (Total)	EPA 365.3	Wastewater	Inorganic Analysis
Residue, Filterable (TDS)	SM 2540 C-11	Wastewater	Inorganic Analysis
Residue, Nonfilterable (TSS)	SM 2540 D-11	Wastewater	Inorganic Analysis

Method Capabilities by NELAP Accredited Fields of Testing

Analytes	Method Number	Program	Chemistry Field
Residue, Settleable	SM 2540 F-11	Wastewater	Inorganic Analysis
Residue, Total	SM 2540 B-11	Wastewater	Inorganic Analysis
Residue, Volatile	EPA 160.4	Wastewater	Inorganic Analysis
Total, fixed, and volatile solids (SQAR)	SM 2540 G, 18th Ed.	Wastewater	Inorganic Analysis
Salinity	SM 2520 B-11	Wastewater	Inorganic Analysis
Silica, Dissolved	SM 4500-SiO_2 C-11	Wastewater	Inorganic Analysis
Specific Conductance	SM 2510 B-11	Wastewater	Inorganic Analysis
Specific Conductance	SW846 9050A	Wastewater	Inorganic Analysis
Sulfide (S)	SM 4500-S B,C + F-11	Wastewater	Inorganic Analysis
Sulfite (SO_3)	SM 4500-SO_3 B-11	Wastewater	Inorganic Analysis
Surfactants (Methylene Blue)	SM 5540 C-11	Wastewater	Inorganic Analysis
Temperature	SM 2550 B-00	Wastewater	Inorganic Analysis
Total Organic Carbon (TOC)	SM 5310 B-11	Wastewater	Inorganic Analysis
Total Organic Halides (TOX)	SW846 9020B	Wastewater	Inorganic Analysis
Turbidity	EPA 180.1	Wastewater	Inorganic Analysis
Metals, Total – Water	SW846 3010A	Wastewater	Metals Prep
Metals, Total – Water, Rec. + Dissolved	SW846 3005A	Wastewater	Metals Prep
Hardness, Total as $CaCO_3$	EPA 200.7	Wastewater	Metals Analysis
Hardness, Total as $CaCO_3$	SM 2340 C-11	Wastewater	Metals Analysis
Mercury	EPA 245.1	Wastewater	Metals Analysis
Metals, ICP	EPA 200.7	Wastewater	Metals Analysis
Metals, ICP/MS	EPA 200.8	Wastewater	Metals Analysis
Mercury, Low-Level	EPA 245.7	Wastewater	Metals Analysis
Mercury, Low-Level	EPA 1631E	Wastewater	Metals Analysis
Mercury, Liquid Waste	SW846 7470A	Wastewater	Metals Analysis
Separatory Funnel Extraction	SW-846 3510C	Wastewater	Semivolatile Organics
Continuous Liquid-Liquid Extraction	SW-846-3520C	Wastewater	Semivolatile Organics
Purge & Trap Aqueous	SW-846 5030B	Wastewater	Volatile Organics
Acrolein & Acrylonitrile	EPA 603	Wastewater	Organics Analysis
Base/Neutrals and Acids	EPA 625	Wastewater	Organics Analysis
Extractable Petroleum Hydrocarbons	NJDEP EPH	Wastewater	Organics Analysis
Organochlorine Pests & PCBs	EPA 608	Wastewater	Organics Analysis

Method Capabilities by NELAP Accredited Fields of Testing

Analytes	Method Number	Program	Chemistry Field
Petroleum Hydrocarbons	NJ-OQA-QAM-25	Wastewater	Organics Analysis
Volatile Organics	EPA 624	Wastewater	Organics Analysis
Semi-Volatile Organics GC/MS, Extract or	SW-846 8270C		Semivolatile
Dir Inj, Capillary	SW-846 8270D	Wastewater	Organic Analysis
Coliform, Fecal (Count per 100 mL)	SM 9222 D-97	Wastewater	Microbiology
Coliform, Total (Count per 100 mL)	SM 9222 B-97	Wastewater	Microbiology
Heterotrophic Plate Count	SM 9215 B-00	Wastewater	Microbiology
Soluble Sulfides	SW846 9034	Solid/Haz. Waste	Inorganic Analysis
Bomb Calorimetry	ASTM D-240	Solid/Haz. Waste	Inorganic Analysis
Bromide, Chloride, Fluoride, Sulfate	SW846 9056/A	Solid/Haz. Waste	Inorganic Analysis
Cation, Exchange Capacity	SW846 9081	Solid/Haz. Waste	Inorganic Analysis
Chromium (VI) Digestion	SW846 3060A	Solid/Haz. Waste	Inorganic Analysis
Chromium (VI)	SW846 7196A	Solid/Haz. Waste	Inorganic Analysis
Chromium (VI)	SW846 7199	Solid/Haz. Waste	Inorganic Analysis
Corrosivity/pH, >20% H2O	SW846 9040C	Solid/Haz. Waste	Inorganic Analysis
Cyanide	SW846 9010C	Solid/Haz. Waste	Inorganic Analysis
Cyanide, Amenable to Chlorine	SW846 9010C	Solid/Haz. Waste	Inorganic Analysis
Cyanide	SW846 9012B	Solid/Haz. Waste	Inorganic Analysis
Extractable Organic Halides	SW846 9023	Solid/Haz. Waste	Inorganic Analysis
Free Liquid	SW846 9095	Solid/Haz. Waste	Inorganic Analysis
Ignitability	SW846 1010A	Solid/Haz. Waste	Inorganic Analysis
Oil & Grease, HEM	EPA 1664A	Solid/Haz. Waste	Inorganic Analysis
Oil & Grease and Sludge, HEM	SW846 9071B	Solid/Haz. Waste	Inorganic Analysis
pH, Hydrogen Ion	SW846 9040C	Solid/Haz. Waste	Inorganic Analysis
pH, Soil and Waste	SW846 9045D	Solid/Haz. Waste	Inorganic Analysis
Phenols (Sample Preparation)	SW846 9065	Solid/Haz. Waste	Inorganic Analysis
SPLP Metals/Organics	SW846 1312	Solid/Haz. Waste	Inorganic Analysis
TCLP Metals/Semi Volatile Organics	SW846 1311	Solid/Haz. Waste	Inorganic Analysis
TCLP Volatile Organics	SW846 1311	Solid/Haz. Waste	Inorganic Analysis
Total Organic Carbon (TOC)	SW846 9060 A	Solid/Haz. Waste	Inorganic Analysis
Metals, Solids	SW846 3050B	Solid/Haz. Waste	Metals Prep
Mercury, Solid Waste	SW846 7471A/B	Solid/Haz. Waste	Metals Analysis
Metals by ICP	SW846 6010B/C	Solid/Haz. Waste	Metals Analysis

Method Capabilities by NELAP Accredited Fields of Testing

Analytes	Method Number	Program	Chemistry Field
Metals by ICP/MS	SW846 6020/6020A	Solid/Haz. Waste	Metals Analysis
Semivolatiles, Acid/Base Partition	SW846 3650B	Solid/Haz. Waste	Organics Prep
Semivolatiles, Alumina Cleanup	SW846 3610B	Solid/Haz. Waste	Organics Prep
Semivolatiles, Alumina Cleanup (Petro)	SW846 3611B	Solid/Haz. Waste	Organics Prep
Semivolatiles, Florisil Cleanup	SW846 3620B/C	Solid/Haz. Waste	Organics Prep
Semivolatiles, Gel Permeation Cleanup	SW846 3640A	Solid/Haz. Waste	Organics Prep
Semivolatiles, Silica Gel Cleanup	SW846 3630C	Solid/Haz. Waste	Organics Prep
Semivolatiles, Sulfur Cleanup	SW846 3660B	Solid/Haz. Waste	Organics Prep
Semivolatiles, Sulfuric Acid/MnO_2	SW846 3665A	Solid/Haz. Waste	Organics Prep
Semivolatile Prep, Waste Dilution	SW846 3580A	Solid/Haz. Waste	Organics Prep
Semivolatile Prep Solid, Sonication	SW846 3550B/C	Solid/Haz. Waste	Organics Prep
Semivolatile Prep Solids, Soxhlet	SW846 3540C	Solid/Haz. Waste	Organics Prep
Semivolatile Prep Water	SW846 3520C	Solid/Haz. Waste	Organics Prep
Semivolatile Prep Water	SW846 3510C	Solid/Haz. Waste	Organics Prep
Volatile, Headspace	SW846 3810	Solid/Haz. Waste	Organics Prep
Volatile, Purge & Trap, Solids–High	SW846 5035H/5035AH	Solid/Haz. Waste	Organics Prep
Volatile, Purge & Trap, Solids–Low	SW846 5035L/5035AL	Solid/Haz. Waste	Organics Prep
Volatile, Purge & Trap, Water	SW846 5030B	Solid/Haz. Waste	Organics Prep
Microwave Extraction	SW846 3546	Solid/Haz. Waste	Organics Prep
Alcohols	SW846 8015B	Solid/Haz. Waste	Organics Analysis
Base/Neutrals and Acids	SW846 8270C/D	Solid/Haz. Waste	Organics Analysis
Chlorinated Herbicides	SW846 8151A	Solid/Haz. Waste	Organics Analysis
DBCP, EDB & TCP	SW846 8011	Solid/Haz. Waste	Organics Analysis
Diesel Range Organic	SW846 8015B/C	Solid/Haz. Waste	Organics Analysis
Dissolved Gas/Aqueous Media	RSK-175	Solid/Haz. Waste	Organics Analysis
Ethylene Glycol & Propylene Glycol	SW846 8260B	Solid/Haz. Waste	Organics Analysis
Extractable Petroleum Hydrocarbons	NJDEP EPH	Solid/Haz. Waste	Organics Analysis
Gasoline Range Organic	SW846 8015B/C	Solid/Haz. Waste	Organics Analysis
Organochlorine Pesticides	SW846 8081A/B	Solid/Haz. Waste	Organics Analysis
PCBs	SW846 8082/A	Solid/Haz. Waste	Organics Analysis
Petroleum Hydrocarbons	NJ-OQA-QAM-25	Solid/Haz. Waste	Organics Analysis
Volatile Organics	SW846 8260B/C	Solid/Haz. Waste	Organics Analysis
Volatile Organics	EPA TO- 3	Clean Air Act	Organics Analysis
Volatile Organics	EPA TO-15	Clean Air Act	Organics Analysis

Method Capabilities—Non-NELAP Methods

Analytes	Method Number	Program	Chemistry Field
Phenols	EPA 420.4	Drinking Water	Inorganic Analysis
Carbon Dioxide	SM 4500-CO_2 C or D	Wastewater	Inorganic Analysis
Iodide	SM 4500-I B	Wastewater	Inorganic Analysis
Nonionic Surfactants as CTAS	SM 5540 D	Wastewater	Inorganic Analysis
Particulate Matter	EPA 160.2M	Wastewater	Inorganic Analysis
Petroleum Hydrocarbons	EPA 418.1	Wastewater	Inorganic Analysis
Phosphorus, Hydrolyzable	EPA 365.3	Wastewater	Inorganic Analysis
Redox Potential vs H^+	ASTM D1498-76	Wastewater	Inorganic Analysis
Specific Gravity	ASTM D1298-85	Wastewater	Inorganic Analysis
Total Organic Content	ASTM D2974-87	Wastewater	Inorganic Analysis
Unburned Combustibles	EPA 160.1+160.4	Wastewater	Inorganic Analysis
Viscosity	ASTM D445/6	Wastewater	Inorganic Analysis
Volatile Suspended Solids	EPA 160.2+160.4	Wastewater	Inorganic Analysis
Weak Acid Dissociable Cyanide Prep	SM 4500-CN I	Wastewater	Inorganic Analysis
Ammonia	EPA 350.1M	Solid/Haz. Waste	Inorganic Analysis
Ammonia	EPA 350.2M	Solid/Haz. Waste	Inorganic Analysis
Base Sediment	ASTM D473-81	Solid/Haz. Waste	Inorganic Analysis
Bulk Density (Dry Basis)	ASTM D2937-94M	Solid/Haz. Waste	Inorganic Analysis
Chemical Oxygen Demand	HACH 8000M	Solid/Haz. Waste	Inorganic Analysis
Chloride	EPA 325.3M	Solid/Haz. Waste	Inorganic Analysis
Combustion, Bomb Oxidation	SW846 5050	Solid/Haz. Waste	Inorganic Analysis
Grain Size & Sieve Testing	ASTM D422-63	Solid/Haz. Waste	Inorganic Analysis
Heat Content, BTU	ASTM D3286-85	Solid/Haz. Waste	Inorganic Analysis
Ignitability (Flashpoint)	ASTM D93-90/SW846 Ch 7	Solid/Haz. Waste	Inorganic Analysis
Multiple Extractions	SW846 1320	Solid/Haz. Waste	Inorganic Analysis
Neutral Leaching Procedure	ASTM D3987-85	Solid/Haz. Waste	Inorganic Analysis
Nitrate/Nitrite	EPA 353.2M	Solid/Haz. Waste	Inorganic Analysis
Organic Matter (Ignition Loss)	AASHTO T267-86M	Solid/Haz. Waste	Inorganic Analysis
Orthophosphate	EPA 365.2M	Solid/Haz. Waste	Inorganic Analysis
Percent Ash (Dry Basis)	ASTM D482-91	Solid/Haz. Waste	Inorganic Analysis
Percent Solids	ASTM D4643-00	Solid/Haz. Waste	Inorganic Analysis
Percent Sulfur	ASTM D129-61	Solid/Haz. Waste	Inorganic Analysis
Phosphorus, Total	EPA 365.3M	Solid/Haz. Waste	Inorganic Analysis
Phosphorus, Hydrolyzable	EPA 365.3M	Solid/Haz. Waste	Inorganic Analysis

Method Capabilities—Non-NELAP Methods

Analytes	Method Number	Program	Chemistry Field
Pour Point	ASTM D97-87	Solid/Haz. Waste	Inorganic Analysis
Reactive Cyanide	SW846 7.3.3.2	Solid/Haz. Waste	Inorganic Analysis
Reactive Sulfide	SW846 7.3.4.2	Solid/Haz. Waste	Inorganic Analysis
Redox Potential vs H^+	ASTM D1498-76M	Solid/Haz. Waste	Inorganic Analysis
Specific Gravity of Solids	ASTM D1429-86M	Solid/Haz. Waste	Inorganic Analysis
Sulfide (S)	EPA 376.1 M	Solid/Haz. Waste	Inorganic Analysis
Sulfite (SO_3)	EPA 377.1M	Solid/Haz. Waste	Inorganic Analysis
Total Chlorine	ASTM D808-91	Solid/Haz. Waste	Inorganic Analysis
Total Kjeldahl Nitrogen	EPA 351.2M	Solid/Haz. Waste	Inorganic Analysis
Total Organic Carbon	CORP ENG 81	Solid/Haz. Waste	Inorganic Analysis
Total Organic Carbon	LLOYD KAHN 1988	Solid/Haz. Waste	Inorganic Analysis
Total Organic Chlorine	ASTM D808-91M	Solid/Haz. Waste	Inorganic Analysis
Total Plate Count	SM 9215BM	Solid/Haz. Waste	Inorganic Analysis
Total Volatile Solids	EPA 160.4M	Solid/Haz. Waste	Inorganic Analysis
Water Content	ASTM D95-83	Solid/Haz. Waste	Inorganic Analysis
Diesel Range Organic	TCEQ 1005	Solid/Haz. Waste	Organics Analysis
Extractable Petroleum HCs	Massachusetts EPH	Solid/Haz. Waste	Organics Analysis
Extractable Petroleum HCs	Missouri DRO	Solid/Haz. Waste	Organics Analysis
Total Petroleum Hydrocarbons	FLDEP FL-PRO	Solid/Haz. Waste	Organics Analysis
Total Petroleum Hydrocarbons	Connecticut ETPH	Solid/Haz. Waste	Organics Analysis
Volatile Petroleum HCs	Massachusetts VPH	Solid/Haz. Waste	Organics Analysis
Volatile Petroleum HCs	Missouri GRO	Solid/Haz. Waste	Organics Analysis

Appendix IV

Laboratory Equipment

Equipment	Manufacture & Description	Serial Number	Operating System Software	Data Processing Software	Location	Purchase
GC-AA	GC Agilent 7890A/FID/Entech AutoAir7000	CN10361127	HP Chemstation	HP Enviroquant	Air Laboratory	N/A
GC-II	GC HP5890/ FID	320A40375	HP Chemstation	HP Enviroquant	Air Laboratory	N/A
GCMS- 5W	Agilent Technologies 5975C / 7890A / Entech7200pre-concentrator pre-concentrator	US13207902/CN13141001/1123	HP Chemstation	HP Chemstation	Air Laboratory	2013
GCMS-2W	Agilent Technologies 5975C / 7890A Entech 7016CA	CN10361158 / US10323601 / CN10361158	HP Chemstation	HP Enviroquant	Air Laboratory	2012
GCMS-3W	Agilent Technologies 5973 / 6890N Entech 7016A	CN10425086 / US41746669 / 1351	HP Chemstation	HP Enviroquant	Air Laboratory	2007
GCMS-Q	Hewlett-Packard 5890ll / 5971 MSD / Entech Air Samp 7000	3033A31092 / 3188A02934	HP Chemstation	HP Enviroquant	Air Laboratory	1993
GCMS-W	Agilent Technologies 5973 / 6890N AS Entech 7016CA	US44621451 / CN10517032 / 1119	HP Chemstation	HP Enviroquant	Air Laboratory	2005
GC-QT	Agilent 6890 / PID / FID / Entech 7032AB-L autosampler	US10148124/1176	HP Chemstation	HP Enviroquant	Air Laboratory	2010
GC-WW	Hewlett-Packard6890 / PID	US00010037	HP Chemstation	HP Enviroquant	Air Laboratory	2010
OVEN – 10A	Entech 3100A Canister cleaner	0404-4596	None	None	Air Laboratory	N/A
OVEN – 10C	Entech 3100A Canister cleaner	0404-4597	None	None	Air Laboratory	N/A
OVEN – 10E	Entech 3100A Canister cleaner	N/A	None	None	Air Laboratory	N/A
OVEN -10F	Entech 3100A Canister cleaner	N/A	None	None	Air Laboratory	N/A
Test Gauge	Ashcroft (TG-1)	None	None	None	Air Laboratory	N/A
Test Gauge	Ashcroft (TG-2)	None	None	None	Air Laboratory	N/A
Test Gauge	Ashcroft (TG-3)	None	None	None	Air Laboratory	N/A
Test Gauge	Ashcroft (TG-4)	None	None	None	Air Laboratory	N/A
DO Meter	YSI-51B	92A035818	None	None	Field Serv.	1998
DO Meter	YSI-55/12ft	00C0598BG	None	None	Field Serv.	2000

PH Meter-10	YSI	JC02538	None	None	Field Serv.	2007
PH Meter-11	YSI	JC02540	None	None	Field Serv.	2010
PH Meter-9	Orion 250A	O18019	None	None	Field Serv.	2007
SCON Meter	YSI-30	J0183	None	None	Field Serv.	2004
Balance- Top Load	Ohaus Adventure AV212 (B-36)	8029131104	None	None	IC Lab	2008
ASE	Dionex ASE 200	99030375	None	None	Inorganics	1999
Balance-Analytical	Ohaus Adventurer (B-24)	1225032523P	None	None	Inorganics	2004
Balance-Analytical	Mettler AE 160 (B-5)	C11620	None	None	Inorganics	1999
Balance- Top Load	Ohaus Adv. Pro (B43)	8032501223	None	None	Inorganics	2012
Balance- Top Load	Denver Inst. Co. XL500 (B-14)	B045530	None	None	Inorganics	Pre-2000
Balance- Top Load	Ohaus Adv. Pro (B52)	B334691952	None	None	Inorganics	2013
Balance- Top Load	Ohaus Explorer (B-16)	E1581119212171	None	None	Inorganics	2001
Balance- Top Load	Ohaus Adventurer (B-21)	E1021218270448	None	None	Inorganics	2001
Balance- Top Load	Ohaus Adventurer AV412 (B-27)	8026251106	None	None	Inorganics	2005
Balance- Top Load	Sartorius TE31025 (B-32)	21950273	None	None	Inorganics	2007
Balance- Top Load	Ohaus Adventure AV212 (B-35)	8029171184	None	None	Inorganics	2008
Balance- Top Load	Ohaus Adventurer-Pro (B-38)	8030441010	None	None	Inorganics	2009
Balance- Top Load	Denver P-214 (B-39)	25450279	None	None	Inorganics	2010
Balance- Top Load	A+D HR-250A (B53)	687601248	None	None	Inorganics	2012
Balance- Top Load	Ohaus Adv. Pro (B37)	8029161122	None	None	Inorganics	2013

Calorimeter	PARR 1261EA	1499	None	None	Inorganics	1996
COD Block	HACH DRB200	11020C0029	None	None	Inorganics	2010
Distillation Block 1	Lachat Micro Distillation system	A2000738	None	None	Inorganics	2010
Distillation Block 12	Lachat Micro Distillation system	A2000726	None	None	Inorganics	2010
Distillation Block 3	Lachat Micro Distillation system	A2000807	None	None	Inorganics	2010
DO Meter	YSI 5000	07B1560	None	None	Inorganics	2008
FIA Analyzer	Lachat Quikchem 8000	13200001620	None	None	Inorganics	
Flashpoint	Koehler – K16200	R07002295	None	None	Inorganics	2010
Flashpoint	Koehler – K16200	R07002563B	None	None	Inorganics	2010
Hg Analyzer	HYDRAA II	64013	Envoy	Envoy	Inorganics	2011
Hg Analyzer	Leeman Mercury Analyzer HYDRAAF Gold+	9003	WIN Hg Runner	WIN Hg Runner	Inorganics	2010
Hg Analyzer 7	Hydra II	64631	Envoy	Envoy	Inorganics	2013v
IC-2	Dionex ICS2000	2090737	Dionex Chrom. Client	Dionex Chrom. Client	Inorganics	2004
IC-3	Dionex ICS2000	2110028	Dionex Chrom. Client	Dionex Chrom. Client	Inorganics	2004
IC-4	Dionex ICS2000	4060060	Dionex Chrom. Client	Dionex Chrom. Client	Inorganics	2004
IC-6	Dionex ICS3000	6040160	Dionex Chrom. Client	Dionex Chrom. Client	Inorganics	2006
IC-9	Dionex IC5000+	13120208	Dionex Chrom. Client	Dionex Chrom. Client	Inorganics	2013
IR Spec.	Buck Scientific HC-404	687	None	None	Inorganics	1997
Oven (Inc-21)	Fisher	N/A	None	None	Inorganics	2014
Oven (Inc-7)	Precision	699030922	None	None	Inorganics	2014
Oven Inc 19	Total Dissolved Solids(180°C)	20-2100149111	None	None	Inorganics	2014
PH Meter-46	Thermo Orion 4 Star	B10299	None	None	Inorganics	2008

PH Meter-47	Thermo Orion 4 Star	B04869	None	None	Inorganics	2008
PH Meter-50	Orion Star Series	B27564	None	None	Inorganics	2010
PH Meter-51	Mettler	14011	None	None	Inorganics	2013
pH Meter-53	VWR Symphony B10P	1223350009	None	None	Inorganics	2013
PH Meter-54	Thermo Orion 710A	X08035	None	None	Inorganics	2013
PH Meter-55	Thermo-Orion	X10686	None	None	Inorganics	2014
pH Meter-57	VWR Symphony B10P	1411150002	None	None	Inorganics	2014
pH Meter-59	VWR Symphony B10P	14087S0006	None	None	Inorganics	2014
PH Meter-60	VWR Symphony B10P	1413950006	None	None	Inorganics	2014
PH-EH Meter-22	Thermo Orion 4 Star	SN00742	None	None	Inorganics	2008
SCON Meter	Amber Science 1056	01020851056-101	None	None	Inorganics	2001
SCON Meter	Orion 145+	78035	None	None	Inorganics	2004
Solvent Evaporator	Horizon SPE-DEX 3000XL	09-1031	None	None	Inorganics	2010
Solvent Evaporator	Horizon SPEED VAP III	09-0739	None	None	Inorganics	2010
TCLP Rotator 4	Assoc. Design and Mfg. Co. 3740-24-BRE-TM	N/A	None	None	Inorganics	2000
TCLP Rotator 5	Analytical Testing Corp. 42R5BCI-E3	0685KZJP0013	None	None	Inorganics	2002
TCLP Rotator 7&8	Assoc. Design and Mfg. Co. 3740-48BRE	N/A	None	None	Inorganics	2000
TCLP Rotator 9&10	Assoc. Design and Mfg. Co. 3740-48BRE	2132337	None	None	Inorganics	1996
TOC-L Analyzer	Shimadzu TOC-L	H52516900071	Shimadzu TOC Control	Shamadzu TOC Control	Inorganics	2012
TOC-L Analyzer	Shimadzu TOC-L	H52515000114NK	Shimadzu TOC Control	Shamadzu TOC Control	Inorganics	2013
TOC-V Analyzer	Shimadzu TOC-V CSH	H52504400192NK	Shimadzu TOC Control	Shimadzu TOC Control	Inorganics	2007
TOX Analyzer	Mitsubishi TOX-100	N/A	None	None	Inorganics	1996

TOX Analyzer	Mitsubishi TOX-100	A7M 42997	None	None	Inorganics	2008
UVVIS Spec E	Spectronix 20 Genesys	3SGD.352011	None	None	Inorganics	2007
UVVIS Spec J	Thermo Electron Corp. Genesys 20	3SGQ235018	None	None	Inorganics	20012
UVVIS Spec L	Thermo Electron Corp. Genesys 20	3SGS073003	None	None	Inorganics	2014
UVVIS Spec M	Spectronix 20 Genesys	3SG82480005	None	None	Inorganics	2013
UVVIS Spec N	Spectronix 20 Genesys	3SGS247010	None	None	Inorganics	2013
IC-8	Dionex IC5000	11030895	Dionex Chrom. Client	Dionex Chrom Client	Inorganics	
PH Meter-23	Thermo Orion Model 310	SN013786	None	None	Inorganics	2008
Hot Block 8	Environmental Express	N/A	None	None	Mercury Prep	
Hot Block 7	Environmental Express	N/A	None	None	Mercury Prep	
ICP	Thermo ICP 6500 Duo	ICP-20074909	ITEVA	ITEVA	Metals	2007
ICP	Thermo ICP 6500 Duo	ICP-20114506	ITEVA	ITEVA	Metals	2011
ICP	Thermo ICP 6500 Duo	ICP-20072601	ITEVA	ITEVA	Metals Analysis	2007
ICP	Thermo ICP 6500 Duo	IC5D20122506	ITEVA	ITEVA	Metals Analysis	2012
ICP	Thermo ICP 6500 Duo	IC76DC134708	ITEVA/QTEGRA	ITEVA/QTEGRA	Metals Analysis	2014
ICP-MS	Agilent 7700 Series	JP12412081	MassHunter Workstation	MassHunter Workstation	Metals Analysis	2014
ICP-MS	Agilent 7700 Series	JP10340551	MassHunter Workstation	MassHunter Workstation	Metals Analysis	2010
Balance- Top Load	Ohaus Adventurer AR3130 (B-26)	1240-P	None	None	Metals Prep	2004
Hot Block 1	Environmental Express	N/A	None	None	Metals Prep	
Hot Block 2	Environmental Express	N/A	None	None	Metals Prep	
Hot Block 3	Environmental Express	N/A	None	None	Metals Prep	
Hot Block 4	Environmental Express	N/A	None	None	Metals Prep	
Hot Block 5	Environmental Express	N/A	None	None	Metals Prep	
Hot Block 6	Environmental Express	N/A	None	None	Metals Prep	

Balance- Top Load	Ohaus Scout II (B-20)	BJ320905	None	None	Methanol Prep	2002
Balance- Top Load	Ohaus Scout II (B-25)	BJ514770	None	None	Methanol Prep	2004
Autoclave	Tuttnauer	1308435	None	None	Microbiology	2011
Incubator (BOD)	VWR	702499	None	None	Microbiology	2011
Incubator (Plates)	Theclo Precision	11T3	None	None	Microbiology	N/A
Incubator(BOD)	ISOTEMP	317646	None	None	Microbiology	2010
Incubator-Water Bath	INC-2	1200991	None	None	Microbiology	N/A
Refrigerator	R-44	0503MCBR980W0087	None	None	Microbiology	N/A
Incubator (Plates)	Thelco Precision	4-D-5	None	None	Microbiology	N/A
Balance- Top Load	Ohaus Adventurer Pro (B-46)	B304755401	None	None	Organic Prep	Pre-2000
Balance- Top Load	Ohaus Adventurer Pro (B-45)	B033051054	None	None	Organic Prep	2002
Balance- Top Load	Ohaus Adventurer Pro (B-42)	B031331113	None	None	Organic Prep	2007
Balance- Top Load	Ohaus Adventurer Pro (B-47)	4755411	None	None	Organic Prep	2013
Buchi -1	Buchi Concentrator System	1000175446	None	None	Organic Prep	2014
Buchi -2	Buchi Concentrator System	1000175108	None	None	Organic Prep	2014
Buchi-3	Buchi Concentrator System	1000175657	None	None	Organic Prep	2014
Buchi-4	Buchi Concentrator System	Not in service	None	None	Organic Prep	N/A
Centrifuge	Thermo Scientific	41394883	None	None	Organic Prep	2014
GPC4	Waters 717	717-000152	None	None	Organic Prep	1992
Microwave-3	MARS 6 CEM	MJ2659 (warranty expires June 2014)	None	None	Organic Prep	2013
Microwave-4	MARS 6 CEM	MJ2198	None	None	Organic Prep	2013
Microwave-5	MARS 6 CEM	MJ2197	None	None	Organic Prep	2013
Mini Water Bath	Thermo Scientific	234221-1379	None	None	Organic prep	2014
N-EVAP 1	Organomation	59301	None	None	Organic Prep	2014
N-EVAP 2	Organomation	58202	None	None	Organic Prep	2014

Sonicator	Fisher	F550	None	None	Organic Prep	N/A
Sonicator	Bransen	BIO3037527	None	None	Organic Prep	N/A
Sonicator	Misonix	S3000	None	None	Organic Prep	1997
Water Bath 1	Organomation	13385	None	None	Organic Prep	2010
Water Bath 10	Organomation	58394	None	None	Organic prep	2014
Water Bath 11	Organomation	58384	None	None	Organic prep	2014
Water Bath 2	Thermo Scientific	176676-1289	None	None	Organic Prep	2014
Water Bath 3	Organomation	58471	None	None	Organic Prep	2010
Water Bath 4	Organomation	58421	None	None	Organic Prep	2014
Water Bath 5	Organomation	58422	None	None	Organic Prep	2014
Water Bath 8	Organomation	58424	None	None	Organic Prep	2014
Water Bath 9	Organomation	58425	None	None	Organic prep	2013
Water Bath 6	Organomation	58423	None	None	Organic Prep	2014
Water Bath 7	Organomation	58379	None	None	Organic Prep	2014
GC-SN	Hewlett Packard 5890 GC/5970 MSD/OI 4551/4560	2623A08318/2637A01687/D538475262/1542 461919	HP Chemstation	Hp Enviroquant	Organics,	Re-Built 2012
GC-SC	Hewlett-Packard 5890 / FID / OI4551 / 4560	2443AO3797	HP Chemstation	HP Enviroquant	Organics; Screening	1990
GC-SR	Hewlett-Packard 5890 / FID / Tekmar 7000	2612A07448	HP Chemstation	HP Enviroquant	Organics; Screening	1992
GC-ST	Hewlett-Packard 5890 / FID / NPD / HP 7673 AS / Tek	314OA38871	HP Chemstation	HP Enviroquant	Organics; Screening	1996
GC-SV	Hewlett-Packard 5890 / FID / OI4551 / 4560	LR47-359C / N244460743 / 3336A58859	HP Chemstation	HP Enviroquant	Organics; Screening	1996
GC 7y/7z	Agilent Technologies 6890N / 7683	US00043006 / US12211759 / CN52926441 / CN60931595	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-5G	Agilent Technologies 7890N/7693	CN12131022 / CN12060027 / CN12070097 / U20782/U20781	HP Chemstation	HP Enviroquant	Organics; SVOCs	2008
GC-5y-5z	Agilent Technologies 7890N / 7683	CN11461115 / CN11380009 / CN11390012 / CN73342671	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-6G	Agilent Technologies 6890N 7683	CN10611064 / CN44330971 / CN40334835 / U4788 / U18013	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-6y-6z	Agilent Technologies 7890N / 7683	CN11461118 / CN10310044 / CN83252932 / CN73342695	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010

GC-7G	Agilent Technologies 6890N 7683	US10606009 / CN53236207 / CN40434847 / U23574/ U24374	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-8y/8z	Agilent Technologies 6890N / 7683	US10240121 / GT030513A / CN43038210 / CN40334821	HP Chemstation	HP Enviroquant	Organics; SVOCs	2011
GCMS-4P	Agilent Technologies 5973 / 6890N AS 7683 AS	CN10251017 / US102440773 / CN34727122 / CN61031719	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GCMS-5P	Agilent Technologies 5973 / 6890N AS 7683 AS	CN10222060 / US21844818 / CN52834726 / CN21725012	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-XX	Hewlett-Packard 6890 / Dual ECD / HP 7683 AS	US00022968 / CN32023953 / CN32030876 / U0109 / U0905	HP Chemstation	HP Enviroquant	Organics; SVOCs	1998
GC-UV	Hewlett-Packard 5890 / Dual FID / OI 4551 / 4560	2921A23322	HP Chemstation	HP Enviroquant	Organics; Volatiles	1996
GC-2Y/2Z	Agilent Technologies 6890N 7683	CN10407032 / CN61633946 / US94209706 / US01112207	HP Chemstation	HP Enviroquant	Organics; SVOCs	2004
GC-OA	Agilent Technologies 6890N / 7683	US10240147 / CN23021337 / CN320308791 / U5591 / U7670	HP Chemstation	HP Enviroquant	Organics; SVOCs	2002
GC-YZ/ZZ	Hewlett-Packard 6890 / 6890	US00011065 / 3527A39121 / 3521A42714 / 3511A42110	HP Chemstation	HP Enviroquant	Organics; SVOCs	2008
GC-EF	Hewlett-Packard 5890 / Dual ECD / HP 7673 AS	2541A06786 / 2942A20889 /F1916 / F5562	HP Chemstation	HP Enviroquant	Organics; Volatiles	1992
GC-LM	Hewlett-Packard 6890 / PID / FID / OI 4551 / 4560 P&T	US00008927	HP Chemstation	HP Enviroquant	Organics; Volatiles	1998
GCMS-L	Hewlett-Packard 5890 / 5970 MSD / OI 4551 / 4560 P&T	2921A22898 / 2623A01291	HP Chemstation	HP Enviroquant	Organics; Volatiles	1992
GC-SY	Hewlett-Packard 5890 / FID / OI4551A / 4560	2643A10503	HP Chemstation	HP Enviroquant	Organics; Screening	1990
GC-1G	Agilent Technologies 6890N / 7683	US10322012 / CN23821917 / CN23326744 / U21778 / U5597	HP Chemstation	HP Enviroquant	Organics; SVOCs	2003
GC-2G	Agilent Technologies 6890N / 7683	CN10450110 / CN24922557 / CN45022276 / U17684 / U7668	HP Chemstation	HP Enviroquant	Organics; SVOCs	2005
GC-3G	Agilent Technologies 6890N / 7683	CN10450109 / CN24922566 / CN45022167 / U7666 / U7667	HP Chemstation	HP Enviroquant	Organics; SVOCs	2005
GC-3Y/3Z	Agilent Technologies 7890A / 7683B	CN10735014 / CN74345941 / CN83252932 / CN73342695	HP Chemstation	HP Enviroquant	Organics; SVOCs	2007
GC-4G	Agilent Technologies 6890N / 7693	CN10361136 / CN10340093 / CN10310033 / U17615 / U17614	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GC-4Y/4Z	Agilent Technologies 7890A / 7693B	CN10832133 / CN84451068 / CN83252936 / CN73342671	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GCMS-2M	Agilent Technologies 5975 / 6890N AS 7683	CN10612028 / US60532578 / CN4593809290 / US82601187	HP Chemstation	HP Enviroquant	Organics; SVOCs	2012

GCMS-2P	Agilent Technologies 5975C / 7890A / 7693	US10237403 / CN10241022 / CN10210021 / CN10180007	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GCMS-3E	Agilent Technologies 5975 / 6890N / 7683	CN10614011 / US61332852 / CN23326747 / US93901916	HP Chemstation	HP Enviroquant	Organics; SVOCs	2011
GCMS-3M	Agilent Technologies 5975B / 6890N / Agilent 7683B	US65125107 / CN10703029 / CN73943902 / US83801832	HP Chemstation	HP Enviroquant	Organics; SVOCs	2007
GCMS-3P	Agilent Technologies 5975C / 7890A / 7693	CN10361100 / CN10361163 /	HP Chemstation	HP Enviroquant	Organics; SVOCs	2010
GCMS-4M	Agilent Technologies 5975C / 7890A / 7683B	US73317574 / CN1074251 / CN74043923 / CN74145736	HP Chemstation	HP Enviroquant	Organics; SVOCs	2007
GCMS-4P	Agilent Technologies 5973 / 6890N AS 7683 AS	CN10251017 / US102440773 / CN34727122 / CN61031719	HP Chemstation	HP Enviroquant	Organics; SVOCs	2011
GCMS-6P	Agilent Technologies 5973 / 6890N AS 7683 AS	CN10536029 / US52420712 / US10310521 / CN55230259	HP Chemstation	HP Enviroquant	Organics; SVOCs	2011
GCMS-F	Agilent 6890 / 5973 MSD / 7683 AS	US00034179 / US01140200 / CN40327643 / CN138822139	HP Chemstation	HP Enviroquant	Organics; SVOCs	1998
GCMS-H	Hewlett-Packard 5890ll+ / 5972 MSD / HP 7673 AS	3336A58190 / 3501A02356 / 3123A25133	HP Chemstation	HP Enviroquant	Organics; SVOCs	1995
GCMS-M	Hewlett-Packard 6890 / 5973 MSD / HP 7683 AS	US00021813 / US802111003 / US81501001 / CN61038860	HP Chemstation	HP Enviroquant	Organics; SVOCs	1999
GCMS-P	Agilent Technologies 5973 / 6890N AS 7683 AS	US10251064 / US21844598 / CN74145733 / CN24828486	HP Chemstation	HP Enviroquant	Organics; SVOCs	2003
GCMS-R	Agilent Technologies 6890 / 5973 MSD / 7683	US00021820 / US81211033 / US84202752 / CN61639349	HP Chemstation	HP Enviroquant	Organics; SVOCs	2008
GCMS-Z	Agilent Technologies 5973 / 6890N AS 7683 AS	US10251028 / US21844586 / CN24828485 / CN23321564	HP Chemstation	HP Enviroquant	Organics; SVOCs	2003
Balance- Top Load	Ohaus Sport (B-28)	7124230518	None	None	Organics; Volatiles	2005
Balance- Top Load	Ohaus Adventure AV412 (B-34)	8028391117	None	None	Organics; Volatiles	2007
GC-AA	Agilent 7890A / AS 7683B	CN10832133 / US08232002	HP Chemstation	HP Enviroquant	Organics; Volatiles	2008
GC-GH	Hewlett-Packard 5890	2938A25059	HP Chemstation	HP Enviroquant	Organics; Volatiles	1990
GCMS-1A	Agilent Technologies 5973 / 6890N AS 4551A / 4660	CN10314026 / US30945331	HP Chemstation	HP Enviroquant	Organics; Volatiles	2003
GCMS-1B	Agilent Technologies 7890A / 5975C /Teledyne / Tekmar AquaTek AS	CN10845177 / US83111119	HP Chemstation	HP Enviroquant	Organics; Volatiles	2008
GCMS-1C	Agilent Technologies 5973 /	CN10425085 / US41746667	HP Chemstation	HP Enviroquant	Organics;	2004

	6890N AS 4551 / 4560				Volatiles	
GCMS-2A	Agilent Technologies 5973 / 6890N AS Tekmar Solatek 72	CN10314028 / US30945325	HP Chemstation	HP Enviroquant	Organics; Volatiles	2003
GCMS-2B	Agilent Technologies 5973 / 6890N AS 4551A / 4660	CN10441033 / US 43146954	HP Chemstation	HP Enviroquant	Organics; Volatiles	2004
GCMS-2C	Agilent Technologies 5973 / 6890N AS 4551A / 4560	CN10441035 / US 43146953	HP Chemstation	HP Enviroquant	Organics; Volatiles	2004
GCMS-2D	Agilent Technologies 5973 / 6890N AS 4552 / 4560	CN10432038 / US43146771	HP Chemstation	HP Enviroquant	Organics; Volatiles	2004
GCMS-2E	Agilent Technologies 5975 / 6890N AS 4551A / 4660	CN10612046 / US60532596	HP Chemstation	HP Enviroquant	Organics; Volatiles	2006
GCMS-3A	Agilent Technologies 5973 / 6890N AS 4551A / 4660	CN10432042 / US43146776	HP Chemstation	HP Enviroquant	Organics; Volatiles	2004
GCMS-3B	Agilent Technologies 6890 / 5973 / OI 4551A / 4660	US10240044 / US21844015	HP Chemstation	HP Enviroquant	Organics; Volatiles	2002
GCMS-3C	Agilent Technologies 5973 / 6890N AS 45551A / 4660	CN10517038 / US44621480	HP Chemstation	HP Enviroquant	Organics; Volatiles	2005
GCMS-3D	Agilent Technologies 5975B / 6890N AS 4551A / 4660	CN10637120 / US62724193	HP Chemstation	HP Enviroquant	Organics; Volatiles	2006
GCMS-3V	Agilent Technologies 5975C/7890A/OI 4552/ 4560	US1321790 / CN13141045	HP Chemstation	HP Enviroquant	Organics; Volatiles	2013
GCMS-4B	Agilent Technologies 5975C / 7890A	US10323601 / CN10361158	HP Chemstation	HP Enviroquant	Organics; Volatiles	2010
GCMS-4D	Agilent Technologies 5975C / 7890A	US10237301 / CN10241019	HP Chemstation	HP Enviroquant	Organics; Volatiles	2010
GCMS-4V	Agilent Technologies 5975C/7890A/OI 4100/ 4660	Us13307901 / CN13331029	HP Chemstation	HP Enviroquant	Organics; Volatiles	2013
GCMS-A	Hewlett-Packard 6890 / 5973 MSD / OI 4552 / 4560 ARCHON	US00033272 / US94212183	HP Chemstation	HP Enviroquant	Organics; Volatiles	2000
GCMS-C	Hewlett-Packard 6890 / 5973 MSD / OI 4552 / 4560 ARCHON	2643A122671 / 2807A1146	HP Chemstation	HP Enviroquant	Organics; Volatiles	1990
GCMS-D	Hewlett-Packard 6890 / 5973 MSD / OI 4551 / 4560 ARCHON	US00030551 / US93122843	HP Chemstation	HP Enviroquant	Organics; Volatiles	2001
GCMS-E	Hewlett-Packard 6890 / 5973 MSD / OI 4551 / 4560 ARCHON	US00031161 / US93112044	HP Chemstation	HP Enviroquant	Organics; Volatiles	2001

GCMS-G	Hewlett-Packard 5890ll / 5970 MSD / OI 4552 / 4660	2919A22540 / 2807A11004	HP Chemstation	HP Enviroquant	Organics; Volatiles	1989
GCMS-I	Hewlett-Packard 5890 / 5970 MSD / OI 4551 / 4560	2623A08318 / 2637A01687	HP Chemstation	HP Enviroquant	Organics; Volatiles	1986
GCMS-J	Hewlett-Packard 5890 / 5970 MSD / OI 4552 / 4560 P&T	2643A11557 / 3034A12779	HP Chemstation	HP Enviroquant	Organics; Volatiles	1990
GCMS-K	Hewlett-Packard 5890l1 / 5970 MSD / OI 4551 / 4560 P&T	2750A116838 / 2905A11628	HP Chemstation	HP Enviroquant	Organics; Volatiles	1990
GCMS-N	Hewlett-Packard 5890 / 5970 MSD / Tekmar 2000 / 2032 P&T	2750A17088 / 2716A10218	HP Chemstation	HP Enviroquant	Organics; Volatiles	1988
GCMS-S	Hewlett-Packard 6890 / 5973 MSD /OI 4552 / 4660 ARCHON	US00024322 / US82311313	HP Chemstation	HP Enviroquant	Organics; Volatiles	2000
GCMS-T	Hewlett-Packard 6890 / 5973 MSD / OI 4551A / 4660 P&T	US00024323 / US82311482	HP Chemstation	HP Enviroquant	Organics; Volatiles	2000
GCMS-U	Hewlett-Packard 6890 / 5973 MSD / HP 4551A / 4660	US00032623 / US94212203	HP Chemstation	HP Enviroquant	Organics; Volatiles	1999
GCMS-V	Agilent Technologies 5973 / 6890N AS 4552 / 4560	US10149085 / US10441917	HP Chemstation	HP Enviroquant	Organics; Volatiles	2002
GCMS-X	Agilent Technologies 5973 / 6890N AS 4552 / 4660	US21843889 / US10239071	HP Chemstation	HP Enviroquant	Organics; Volatiles	2002
GCMS-Y	Agilent Technologies 5973 / 6890N AS 4552 / 4560	US10240013 / US21844012	HP Chemstation	HP Enviroquant	Organics; Volatiles	2002
GC-PF	Agilent Technologies 6890N AS 4552 / 4560	US10235024 / 12995 / J542460192	HP Chemstation	HP Enviroquant	Organics; Volatiles	2002
PH Meter-13	VWR IS B20	5942	None	None	Sample Management	2010
Balance- Top Load	Ohaus Adventure AV412 (B-33)	8028391184	None	None	Sample Management	2007
Balance- Top Load	Ohaus Adventurer AV412 (B-30)	8026391160	None	None	Screen	2005